THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

(J. A. BERLY'S).

1907 Edition

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COMMERCIAL DEVELOPMENT OF ELECTRICITY SUPPLY.

PERHAPS one of the most striking features of the past year in connection with the electricity supply business has been the rapid evolution of the commercial sales department. Developing from an insignificant auxiliary in those few enterprising stations which had the temerity to put into practice new methods and ways that were not in accordance with the ordinary ideas of conducting a similar business, in many cities and towns it is now beginning to be considered as a most important factor in the arrangements for the distribution of electricity from a common centre—an essential feature rather than an expensive luxury. Many of those towns which have not as yet inaugurated such a department have, from all accounts, reached a point where they are seriously considering its institution.

This activity has led to a general demand for definite information as to practical methods and means concerning the details of operation of this new departure in central station work, which we have endeavoured to meet during the past year by the publication of articles from time to time, concluding with a special series of notes by an expert on the subject. These articles and notes have been so much appreciated that we are making arrangements again to deal with the subject in a thoroughly practical manner during the current year.

We are confident that the assistance given by these articles will be extremely valuable to those organising or in charge of a commercial sales department. We do not, of course, pretend to say that any article, however ably written, could prove a satisfactory substitute for the personal advice of a specialist, whose practical experience would cover the many emergencies and special conditions that would be sure to arise. Experience of this kind is slowly obtained and often dearly bought, and it is, therefore, indubitably cheaper to purchase an expert's experience. To any who find it impossible to secure personal advice, we feel sure that the assistance given in these columns will afford the nearest substitute.

It has been suggested that we should devote a certain space to the answering of queries dealing with the problems arising in the organisation and operation of central station commercial sales departments. As this subject is so new, and presents so many difficulties on that account, we have decided to do so, providing there is sufficient demand for it, and to that end have made arrangements with our contributor, Mr. R. Borlase Matthews, who has had exceptional experience in commercial development, to take charge of this feature. As our space is limited, we can only deal with queries of general interest. Questions should be direct and to the point, and the contingen conditions should be mentioned, as these latter have

of course, a very important bearing on the answer. The usual rules of our correspondence columns will be adhered to.

This matter of the Commercial Development of Electricity Supply is one that concerns all classes of electrical engineers, not merely those whose special duties are in connection with the generation and distribution of electrical supply. In this country nearly half the population, and that the portion which includes the more well-to-do class of inhabitants, is within the territory of public electricity supply undertakings, and if a very large proportion of these people are persuaded to take advantage of the supply, the electrical industry as a whole is going to benefit in all directions, as the increased demand for electricity will mean an increased demand for electrical apparatus and supplies of all kinds, both for the consumer and for the central station.

What is a Board of Trade Unit?

This question savours of absurdity. Surely everybody knows the answer—the Board of Trade not excepted. The Board has prescribed the precise form, dimensions and weight of the ohm, ampere and volt, and in the schedule to the Form of Provisional Order under the Electric Lighting Acts, 1882 and 1888, it is quite clearly stated that "The expression 'unit' shall mean the energy contained in a current of 1,000 amperes flowing under an electromotive force of 1 volt during one hour." Further, the supply undertaker may charge for energy supplied, either "By the actual amount of energy so supplied"; or "By the electrical quantity contained in the supply"; or by some other approved method. When charging according to the electrical quantity, the amount of energy supplied is to be "taken to be the product of that electrical quantity and the declared pressure at the consumer's terminals."

But what about the power factor?

The foregoing prescriptions are unimpeachable when applied to direct-current supply; but, apparently, in the absence of a well-defined agreement between supplier and consumer, the former is entitled to charge on the basis of the product of volts and ampere-hours, regardless of the power factor of the load. It may be suggested that the volts and amperes themselves, if alternating, are not defined, but as the Board's standard volt and ampere are ascertained by means of apparatus which obeys the root-mean-square law, this is not so. The fact remains, however, that—so far as we can ascertain—the statutory definition of the B. of T. unit ignores difference of phase between current and pressure, and thus lays open the way to disputes and actions at law. The defect could easily be remedied—for instance, by officially identifying the "unit" with the kilowatt-hour.

America and the Copper Crisis.

The years 1905 and 1906 have been marked by extraordinary activity in the American copper refining and smelting industries. On this side, we have had copper rising during the latter year from under £80 to £90, and subsequently to £107, per ton, together with a boom in copper mining shares, which have become more fashionable in speculative circles than gold mining shares. High prices for the metal have meant great activity at the mines, and the favourable dividends yielded by some of the older mines have led to the flotation of a large number of mining companies which cannot become immediately productive.

Contrasting the two years, however, one salient feature distinguishes their characteristics. An important reason for the rise in 1905 lay in the heavy Chinese purchase of copper in connection with a re-coinage scheme. The rise in price towards the end of that year even led to the repurchase of some of the consignments. The continued firmness in 1906 must be attributed entirely to the improved condition of the engineering trades, and to the expansion of various electrical industries. The increase in electric lighting, railway electrification, telephone construction and power distribution schemes will tend to maintain copper at its present high price, or even to carry it over £110 per ton, a price as unthinkable three years ago as the old price of 80s. per quarter for corn of the early days of the nineteenth century is to-day.

A point to be remembered in this connection is that the United States is becoming more and more a consumer of the copper which it produces, and now consumes a volume in excess of the entire production in 1899. Official figures are now available for 1904 and 1905, the following being millions of pounds:—

	1904.	1905.
Official estimate of production in U.S.A. ...	812·5	901·3
Official estimate of consumption in U.S.A. ...	482·2	581·0

Although we are not yet able to give exact figures for the year just ended, it is an indubitable fact that the trend shown above will be more strongly marked, as the visible supply is very low, and the greatly increased production of 1906 has been absorbed by the increased demand.

As to the future of prices and production during 1907, the United States is really the storm centre to be watched. The heavy local demand there has tended to "boost up" prices. This local demand has occasioned intense local activity, which will end in the supply overtaking the home demand and affording surplus stocks which engineering manufacturers here will be only too glad to have dumped upon the London market. At present old properties in the Lake Superior region are being reopened, and prospecting is being vigorously carried out. Great activity is reported from Montana, Nevada and Arizona; new smelting plants are being laid down in Utah and California. In Tennessee the smelting plant is being enlarged, while a new smelter has been started in Massachusetts. Even in Alaska the ore has been smelted locally since the close of 1905, thus saving the cost of transport to distant smelters.

The Raising of Capital in Germany.

The co-operation of German banks seems to render it a fairly easy matter to raise capital for remunerative undertakings even in present times, with a bank rate now at 7 per cent. This conclusion is drawn from the proceedings at the recent meeting of the Berlin Elevated and Underground Electric Railway Co., which requires additional funds for the purpose of extensions of works and equipment. The directors proposed to raise £500,000 by the creation of new shares, to be issued without the present shareholders having the right to subscribe. It appears that the Electric Light and Power Investment Co., which stands in close relations with the Deutsche Bank, had offered to take over the whole of the emission at the rate of 110 per cent. and to pay 25 per cent. of the amount and also the premium on January 2nd, 1907, although the shares will not be entitled to dividend until 1909, whilst at the same time the transfer of the shares would not be permitted without the consent of the directors of the railway company. It was explained that it was inadvisable to offer the new capital to existing shareholders, as further payments would not be made on the shares before 1910, and because of the slight claims of the new shares to dividend distribution, the relatively high price and the complicated conditions as to transfer. Some objections were raised to the proposal to leave the shareholders out of consideration in regard to subscription, but the directors' scheme for accepting the offer was eventually adopted by a large majority, including banking interests represented by the Deutsche Bank, the Berlin Handels Gesellschaft and the Central German Credit Bank.

WIRES OVER STREETS AND HIGHWAYS.

[FROM OUR LEGAL CONTRIBUTOR.]

In view of certain queries which have recently been addressed to us in relation to the right of private persons and companies to suspend wires over streets and highways, it may be of interest to set forth the law upon the subject.

That part of the law of England which treats of the rights of persons to suspend wires across streets and highways is full of anomalies, and it is not surprising that those who have to do with the transmission of electricity from place to place should sometimes fail to understand it. A short statement of the legal principles which affect the question, and of the way in which those principles have been modified by statute, may serve to dispel some of the doubt, which has been expressed on the subject.

The Law Independent of Statute.—Primâ facie every landowner has the right to suspend wires over his land. The owner of the soil has a proprietary right *a cælo usque ad inferos*. Conversely, if any one suspends wires over land without the consent of the owner of the soil, the owner may cut them down or sue the person who put them up for trespass. This being a short statement of so much of the law as affects private land, what is the principle applicable to streets and highways? Apart from statute, the sole question is, Who owns the soil of the highway? In nearly every case the soil of the highway is vested in the frontagers on either side. To use the Latin phrase, they each own the soil of the road *usque ad medium filum viæ;* and therefore they are entitled to say what shall and what shall not be suspended over it. In the case of streets and highways, however, the highway authority (which may be the council of a county, or an urban or rural district council) have a right to insist that nothing shall be suspended over the road which will interfere with the traffic. To suspend a cable across a street at a height of 8 ft. above the crown of the road would be to do something which would occasion a nuisance to the public. But so long as the cable or wire is suspended sufficiently high, it is competent for any person by making an agreement with the frontagers, to adopt this means of transmitting electricity from place to place.

The only exception to this general rule occurs in places where the highway authority happen to have the soil or freehold of the street or highway vested in them. In such circumstances the highway authority may exercise all the rights of a private owner and prevent wires being suspended over their property. It may be stated at once, however, that so far as can be ascertained there are very few places in the United Kingdom where the highway authority has any such right.* An attempt was made to establish the existence of such a right in the borough of Finchley, but it was declared non-existent by the Court of Appeal in the case of Finchley Electric Supply Co. *v.* Finchley U.D.C. (1902, 1. Ch. 866).

Statutory Modification of the Law. (*a*) *The Electric Lighting Acts*, 1882-1888. Having outlined the common law upon the subject under discussion, it is necessary to see how far, if at all, it has been modified by statute. The Electric Lighting Act, 1882, laid down certain general principles in accordance with which a local authority or a company, referred to in the Act as "undertakers," might obtain Parliamentary powers to supply electricity. It is all-important to note that this Act did not compel any company or person desirous of supplying electricity to do so under a provisional order or special Act; it merely conferred certain benefits and imposed certain obligations upon companies who apply for and obtain a provisional order. It is provided by Sec. 14 of this Act that "undertakers shall not be authorised to place any electric line above ground along, over, or across any street without the express consent of the local authority." This provision makes it plain that where a company have obtained statutory power to supply electricity within a certain district, they cannot suspend wires over streets and highways unless they obtain the consent of the highway authority; but the section does not affect the rights or liabilities of private persons who, in spite of the Act of 1882, are entitled to suspend wires across streets and highways, if those wires do not interfere with the traffic.

It may here be mentioned that in addition to the powers conferred by Sec. 14, some corporations have had more stringent powers conferred upon them by their private Acts. See, for instance, the Southport Corporation Act, 1900, Sec. 54; the Manchester Corporation Act, 1882, Sec. 47; the Darwen Corporation Act, 1899, Sec. 94; and the Blackburn Corporation Act, 1901, Sec. 122. In each of these cases the corporation have power to withhold their consent to the suspension of wires; but in some instances the consent can only be withheld if it is shown that the electric line is a menace to the public safety.

It having been found that the Act of 1882 made no provision for cases where private individuals or private companies suspended cables over streets and roads, the Legislature took steps to deal with the matter. The following Acts are to be referred to in this connection, namely, the Electric Lighting Act, 1888, Sec. 4; Part II of the Public Health Acts Amendment Act, 1890; and the London Overhead Wires Act, 1891. Reading it shortly, Sec. 4 (1) of the Act of 1888 provides that where in any case any electric line may have been erected across any street for the purpose of supplying electricity, or where any electric line so erected may be used otherwise than under and subject to the provisions of a licence or provisional order, the Board of Trade may serve a notice requiring the same to be used only in accordance with such conditions and subject to such regulations for the safety of the public as may be prescribed by the Board. This section gives no jurisdiction to local authorities. The Board of Trade regulations under this section were made in 1897. They make provision for, *inter alia*, the height of wires from the ground; the angle of street crossings, and the use of suspending wires. They do not apparently place any undue restriction upon the use of wires over streets.

Subject, then, to the few cases in which the soil of the highway is vested in the local authority, there is nothing in the Electric Lighting Acts to prevent any person or company from suspending cables over a highway without the leave or licence of the local authority. As has been shown, the Board of Trade is the only body which has any such power conferred upon it by these statutes.

(*b*) *The Public Health Acts Amendment Act, 1890.*—We have next to consider Part II of the Public Health Acts Amendment Act, 1890. This Act does not apply to London. It is an adoptive Act, that is to say, it does not come into force in any district unless it is formally adopted by the urban district council. It empowers that body to make by-laws for the prevention of danger or obstruction to the public from posts, wires, tubes, or any other apparatus stretched or placed above, over, along or across any street, for the purpose of any telegraph, or any other purpose. The words other purpose must be taken to include electric lighting, and the transmission of power by electricity. By-laws so made must be confirmed by the Board of Trade. Rural authorities may be vested by the Local Government Board with urban powers for the purpose of the Act. The Act does not extend to any works of any undertakers within the meaning of the Electric Lighting Acts 1882 to 1888, and it is all-important to notice that it does not *prohibit* the use of overhead wires and cables; it merely empowers a local authority to make by-laws for the protection of the public. Provided those by-laws are complied with, the local authority would have no power to prevent the suspension of cables.

(*c*) *The London Overhead Wires Acts, 1891.*—Within the Metropolitan area, wires and cables may only be suspended subject to and in accordance with the provisions of the London Overhead Wires Act, 1891. By this Act the London County Council may make by-laws providing for the regulation of wires, the strength of the materials to be employed in placing, maintaining and supporting them. It also provides for the giving of notice to the County Council and the local authority, and the delivery of plans showing the route of the proposed wires. Nothing in this Act applies to the works of undertakers within the meaning of the Electric Lighting Acts; nor does it prohibit the suspension of wires; it merely provides that the by-laws shall be complied with.

Conclusions.—Enough has been said to show that it is

* We should be obliged to any reader who can give us information on this point.—Eds. E.R.

generally accurate to say that local authorities have no jurisdiction to prevent the suspension of cables for electric lighting over highways unless the cables are the property of an electric lighting company exercising Parliamentary powers for the supply of electricity. There are two exceptions to the general rule—(*a*) If the fee simple of the highway is vested in the local authority, and (*b*) if the local authority in question has obtained some special and exceptional Parliamentary powers conferred by a private Act.

In actual practice, any private company or person supplying electricity to his neighbours may often desire to suspend cables across the roads or streets. Before taking any steps in the matter, he should consult his solicitor with a view to ascertaining whether the Public Health Acts Amendment Act, 1890, has been adopted in the district. If it has, a copy of the by-laws made under the Act must be procured. He should also procure a copy of the Board of Trade Regulations made under Sec. 4 of the Electric Lighting Act, 1888. His solicitor would be able to tell him, after making the necessary inquiries, whether the highway authority owned the fee simple of the road. If so, it would be dangerous to proceed without the consent of that body ; but if the soil of the road is vested in the frontagers, the necessary agreements could be prepared with those frontagers upon whose land the supporting posts would have to be erected.

CORRESPONDENCE.

Letters received by us after **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Metallic Filament Lamps.

In reply to "Tantalised," during the past year I have had some 15 pairs of tantalum lamps on the streets for public lighting purposes. I have just reckoned up the average life of these lamps, and find it to be 756 hours. By no means all these lamps were burnt out when removed, as I had any lamp which showed marked signs of senile decay replaced, without waiting for its death.

With regard to the over-running of these lamps, I may say that many of the above were decidedly over-run, as during the first part of the above period I used two 115-volt lamps in series on a normal 230-volt circuit. For some time past I have been using 120-volt lamps where they are situated near a feeder, and where the pressure is much in excess of 230 volts.

I have reason to believe that I shall thus obtain a much better life even than the above, without serious diminution in the light given. The fact that the tantalum lamp is not very sensitive to changes in voltage is one of its highest recommendations in these days when lift motors and other unsteady characters disturb the equanimity of the bus-bar voltmeters.

A. C. Hanson,
Burgh Electrical Engineer.

Stirling, *January 2nd*, 1907.

Your correspondent "Tantalised" asks for the experience of contractors with tantalum lamps. Perhaps my experience with three 72-volt lamps burning on the Barnes Council's supply may be of interest.

I started these lamps in September last, and up to the last day of the year they had been entirely satisfactory, giving a good white light and taking ·35 ampere. On January 1st I found one filament broken. I had, therefore, to resort to a white-light lamp, but the change was so distressing that I determined to experiment on the broken lamp : switching the lamp on, I shook the lamps until the broken ends fused together. The lamps are now burning as well as ever.

This ability to weld the broken filament is certainly a distinct advantage over carbon filaments.

Welded.

I have read with interest the various letters on tantalum lamps, as I have used these lamps in a flour mill for some time. My first experience was with 100-volt 25-C.P. lamps. These lamps suffered most where the vibration was greatest : for instance, on the roller floor, where I could only get from six to 200 hours life ; two storeys above the vibration is less, the lamps burnt from 200—600 hours. I tried a few more of these lamps in a position of greatest vibration, one fixed with a spring, the other with gas pipe, the result was, three lamps, with spring, 225 hours ; nine lamps, with gas pipe, 1,420 hours. To give tantalum lamps another trial, I placed 100 13-C.P. lamps, and 50 21-C.P. lamps, in workshops and warehouses. Here they are giving every satisfaction, most of them burning night and day ; I have received no lamps yet with badly fitted contacts, such as "Chief Engineer" stated in his letter, January 4th. I have now on order 200 21-C.P. lamps, and am also sending an order for 100 13-C.P. lamps. On the whole I find tantalum lamps no more trouble than carbon filament lamps—of course, where there is less vibration ; the carbon filament gets so dull after a few hours burning.

A. E. A.

I must confirm what "Chief Engineer" says in your issue of January 4th, that the blob of solder is the most unsatisfactory feature of the tantalum lamp, for in some cases it is impossible to get the lamp into its position in the holder until it has been reduced.

A. Butler.

Referring to the letter in your current issue from "Another Station Engineer," surely there is something wrong if electric lighting consumers are going back to gas when current is 3d. per unit and gas 2s. 5d. per 1,000 cb. ft. I should very much like the names and addresses of those consumers ; I think I could show them that the electric lighting is very considerably cheaper than gas if properly arranged.

B. H. Jenkinson.

London, W.C., *January 4th*, 1907.

With the object of giving the tantalum lamp a trial for domestic purposes, I purchased one dozen of the 105-volt 22-C.P. clear lamps and fitted them on October 20th, 1906, to a 105-volt D.C. circuit.

The first one of the lot had to be discarded on December 31st last, as it had blackened and the light had fallen off so badly as to render it of no further practical use.

The estimated life of this lamp, taking 5 hours per day —an outside estimate—for 10 weeks = 350 hours, a figure which is a little short of the 600 hours claimed for it by advertisers.

With reference to the experience of "Tantalised" in running tantalum lamps brilliantly at one-third the stated voltage, I am sorry to say that my own candle-power voltage tests do not bear him out, as the following figures show :—

Lamp.—S. & H. 110-volt tantalum clear "side on."

Supply.—220-volt 300-ampere storage battery reduced through shunt regulators.

Volts	90·2	100·4	109·0	119·6
Candle-power...	7·0	11·4	15·8	21·5

Tantalus.

The Qualifications of a Shift Engineer.

In reply to your correspondent, "A Young Hopeful," I would say that neither influence, experience nor money, in any great abundance, is absolutely essential to a young fellow becoming an engineer. If he is made of the right stuff, and not afraid of work, he should get into an engineering works as a fitter-apprentice ; he will find plenty of works up and down the country where he can get in without paying a premium, and get a wage of 5s. per week to commence, increasing to 12s. or 14s. in the four or five years of his apprenticeship. Whether he gets a good practical training as a mechanical engineer or not, will depend entirely on

himself and his application to his work. To get his theoretical training, he must attend the technical school evening classes. Of course, it is understood that any man obtaining his training in this manner is severely handicapped with the man whose parents can afford to pay £400 or £500 for his training, but if he is prepared to work hard there is no reason why he should not be as good an engineer at the end of his apprenticeship.

With regard to Mr. McDonell's letter, he will see by my last article that I have counted the cost to the shift engineer to attain the required qualifications, and our figures agree almost exactly; but I cannot agree with him over the last part of his letter where he says, "If lucky to get it, he may settle down until someone dies, and there is a general shuffle of chiefs." The days when influence alone without good qualifications was sufficient to get a man into a good position are happily dead—or, at most, in rapid decline—except, perhaps, in a few small concerns.

Electricity works have grown so rapidly, and there is such an immense capital sunk in them, that owners (whether municipal or private) cannot afford to risk their concern in any but the most capable hands. If the shift engineer has the qualifications enumerated in my first article, and takes his work seriously, he has every prospect of rising to something higher than chief assistant at £120 a year in a small concern.

W. Mayall Milnes.

Electricity Works, Burnley,
January 3rd, 1907.

I have read with interest the able articles by Mr. Milnes on the above subject, and I quite endorse the suggestions made by him in regard to the early training and qualifications of a shift engineer.

As a young engineer who has had to make the very best of small opportunities, I can also agree in full with that gentleman when he says that many young fellows have, by systematically attending evening classes, experienced no great difficulty in obtaining the all-important theoretical training. One meets a large number of good men, holding prominent posts, who, in early days, have, through lack of funds, had, like the writer of this letter, to burn the candle at both ends, an expensive pupilage and college training being entirely out of the question.

The object of this letter, Sir, is to call attention to yet another way of becoming a shift engineer; it may, in fact, be called the royal way to the latter berth; it is, to pay the local borough electrical engineer your £50 or less, and in a matter of two years you will become a *fully qualified* shift engineer. If, at the end of that term, it is not opportune to push a good man on one side, so that "my lord pupil" may reign—well, let him be styled the mains engineer.

It is not my intention to say that borough electrical engineers should not be permitted to take pupils—far from it; but what I do say is, that these young men ought not to be accepted without having previously spent a couple of years at least in a good engineering shop. By this means, they will at the end of a month or two be of some use to their chief, especially if the latter acts honestly by them and makes them work hard, and not merely saunter about the works.

I have seen the responsibilities in connection with the running of heavy central station plant put upon very shaky young shoulders in the person of these young gentlemen, and more often than not by favour.

It is highly amusing to watch their application in matters mechanical, and generally electrical, too; to listen to their interpretation regarding the difference between a Whitworth thread and a B.A. thread is more than laughable, not to mention other things associated with the boiler house.

I could describe instance after instance where these ill-equipped individuals have brought disaster to a station staff, to say nothing of the plant, and at the same time the good name of the works in the eyes of practical men who come and go.

How utterly hopeless then the incapabilities of these raw recruits become in nine cases out of ten. The labourers about the works see through them, and lose confidence in them, and if they possess, as many of them do, the airs of a lord, matters become worse.

Mr. Milnes says the shift engineer must be able to handle men, but I fail to see how, in the average station, this boy pupil is to obtain this all-important asset, for men he has never seen. One knows that to be able to direct average men, means, that you must have worked with them, eaten with them, and almost slept with them; a condition only to be met with by roughing it on the hard roads of the workshop.

I have known cases where the poor deluded pupil, having discovered at the end of his two years his want of proficiency, has begged his parents to spend yet a little more money so that he might enter a good engineering shop. In other instances, perhaps, the youth has gone a little more to the point and has requested definite assistance from the man who undertook to look after his guineas, and more often than not the kind contractor has given him a lift.

Borough electrical engineers and chiefs of supply stations in general, would bestow a lasting benefit on their pupils, if they would make it a condition not to accept them without their having been in the shops prior to entering supply works. It remains, of course, to be said that many fellows have got on well from such as their chiefs gave them, and the writer has many friends thus placed; but after all, they will in many cases never be good practical mechanics.

Such a training, then, as Mr. Milnes outlines cannot be had in the average electricity works, for many of them have no shop at all; in fact, I have known and worked in stations where the fitter had to borrow, for all time, the contractor's tools without his permission.

Fitness.

The Management of Electrical Undertakings.

With reference to the interesting series of articles by Mr. Matthews that you have published, it would serve a useful purpose if you could induce engineers to give particulars of systems of office management that they have found useful.

For example, enclosed is an order form from a duplicate order book which is used both for those who issue and those who receive the order; the properly-drawn order is more appreciated and more likely to receive proper attention. Such

No. 400 System of supply— H.T., 2,000 volts 3-phase. L.T., 200 volts. Periodicity 50. **ORDER.**

NO GOODS DELIVERED WITHOUT A SIGNED ORDER.

Electric Light Station,

190

Catalogue No.	Terms: / Delivery: / Carriage:	Quantity.
	Please supply—	

For **ELECTRIC SUPPLY CO., Ltd.,**
Signed,

N.B.—Invoice to be forwarded on delivery of Goods. The number of this Order must appear on the Invoice.

orders can be posted for ½d., so it is economy to have them printed even when required only on a small scale.

Could you publish a printed form for preparing estimates for installing electric light? So many oversights and errors are liable to occur in such estimates that it would yield a good return for one of the leading manufacturers of fittings, &c., to issue such a book.

£ s. d.

Rail Corrugation.

In a letter on "Tramway Depreciation," *vide* ELECTRICAL REVIEW, March 18th, 1904, I stated that, "in my opinion, the present type of grooved girder rail can be improved,

especially in the distribution of the metal." In *Electricity*, June 3rd, 1904, dealing with the form of cross-section, I wrote "that I suggest a flatter and wider rail head (or tread) in preference to a narrow and deep one, because the interior of the head wears so much more rapidly than the exterior or surface metal; therefore, it is more economical, possessing greater durability, and, further, suggest that the rail tread should be about 2 in."

In old steam railroad practice the rail head was deeper and of less width than those now used, it being now found more efficient to use rails whose heads are wider and less in depth. My object in making the above-quoted "extracto" statements was to draw attention to that particular point—viz., the cross-section. I think that both practical and financial advantages will accrue by re-rolling defective rails, and in so doing modifying the cross-section of the rail head by taking, say, 15 per cent. out of the depth, and placing its equivalent in the width; for by so doing, the advantage will be gained of an increased bearing and wearing surface, possessing the very durable "skin strength," as I consider that a surface depth of $\frac{1}{16}$ in. is fully equal in durability to double the depth in the softer internal and less homogeneous mass of the metal, providing, of course, that we have a sufficiently wide tread. To my mind, there is an "economical" or "maximum efficiency" distribution of head metal or form of cross-section, and it certainly is not in the direction of excessive depth. In addition to the "skin strength" advantage, a wide head of less depth will provide a physical condition for a more thorough mechanical treatment resulting in a more homogeneous molecular structure through the whole mass, than is obtainable with the present form of cross-section. However, these special and important considerations, to which I wish to call attention, are fully explained in the excellent and timely letter submitted by the York Transverse Rolling Process Co.

The valuable information, common sense reasoning and practicability of the suggestions set forth therein are well worthy of thoughtful and serious consideration by tramway authorities and others who have experienced corrugation evils; and it is to be hoped that definite action will now be taken to practically demonstrate or experiment on the lines suggested. Probably some of our enterprising Corporations such as Glasgow, or Leeds, will take steps to work along a direction which, I feel confident, will ultimately prove of practical and financial advantage to the tramway world in general. Adverting to my suggestion as to form of cross-section, I see no substantial reason why anyone who intends to try the re-rolling of rails, should not move away from the conventional path and put into practice an original idea which will, I think, prove highly efficient. I duly appreciate Mr. Thom's remarks and his reasoning as to the re-rolling and probable re-appearance of corrugations, but I feel confident that any rail of suitable chemical composition, subjected to re-rolling at a proper temperature and shaped into a suitable cross-section of head and generally treated on the lines set forth by the York Rolling Process Co., will entirely escape corrugation evils, and that it will also prevent them, if new rails are mechanically treated on the lines indicated.

Wm. R. Bowker.

Manchester, *January 5th*, 1907.

What was Expected of an Electrician.

I should very much like to hear the opinion of some of the readers of the Electrical Review regarding what they think is a fair day's work for one man to do, say, from eight till six; perhaps there are some who may have met with the same experience as myself. I will try, in as few words as possible, to relate an experience I had a few weeks ago, with a firm of wiring contractors in the Eastern Counties. They advertised for an electrician well up in all branches; I applied for the post, and after having a personal interview, was accepted and promised a permanent job. Thinking by the inducements held out to me that the job was all right, I took it.

I was soon to find out, to my sorrow, what the job was like. I was expected to do all wiring, fetch and carry all materials, and have no assistance of any kind. I do not profess to be a genius, but at the same time I have had good sound practical experience, and have excellent testimonials for good work of a lasting character, and have not been used to doing work which will not bear inspection. I am afraid that is not the case with some of the work that is carried out now, especially when it is cut as low as the ridiculous price of 6s. 6d. a point.

I will give you a few items that were expected of me, and the absurd time to do them in. First, to wire four houses for eight hole indicators; wires to be in zinc tube and walls plugged. These were expected to be done in two days. I think, myself, that it could hardly be done by two men, considering under what circumstances the work had to be done, the firm having no steps or ladders—not even a boy to get any materials that might be wanted. Secondly, wire for nine lights and eight bells, the light wires to be chased in the wall in Simplex and the bell wires in zinc tube; this was to be done in a day and a half—a thing, to my mind, not to be done by two men, let alone one; and when I told them that no man could do it, they said that somebody would have to, and as I asked for my time sheet, being utterly disgusted, perhaps someone would like to try to perform this miracle.

Anyway, their motto is not like the one adopted by a firm with whom I was a short time ago, which was—

If a job is worth doing,
It is worth doing well.

Conscience.

Wireless Telegraph Conference.

An anonymous correspondent can, of course, write anything without suffering public obloquy when his considered and deliberate statements are shown to be incorrect; but defiances, however valiant when their authorship is acknowledged, are both contemptible and ridiculous when uttered by someone who does not sign his name.

"Your Correspondent" in the article which he originally communicated, made a number of incorrect and misleading statements, the character of which I exposed. In reply he evaded the issues, and made a futile attempt to show inconsistency between the position I took in my letter of November 27th, and that which I have taken at other times in relation to matters with which it dealt. He now fixes on one point—the Admiralty contract.

In his original article, among other perversions of the truth with regard to the relations between the Admiralty and our company, he said that the Admiralty was "not compelled to purchase any more apparatus from that company" (*i.e.*, the Marconi Co.) "except jiggers and trays of Leyden jars." In addition to exposing the misleading character of his statements generally with regard to our Admiralty contract, I said specifically, "It is incorrect to say that 'the Admiralty is not compelled to purchase any more apparatus from the Marconi Co. except jiggers and trays of Leyden jars'; there is other wireless apparatus which is not at the disposal of the Admiralty unless purchased from the Marconi Co."

In a later letter, in view of the forms of words which "Your Correspondent" appears to think it permissible to employ, I said that my statement was no mere verbal quibble but a fact; and that if "Your Correspondent" referred to the Admiralty on the subject he would find I was correct. He now implies that he has applied to the Admiralty, and has found that my statement is incorrect.

It is impossible for me to believe, on the mere statement of an anonymous correspondent who has already been shown to have perverted a number of facts, that anyone in authority in the Admiralty has made a considered and authoritative statement that the Admiralty has not contracted not to purchase from any person or company other than the Marconi Co., under the terms of Clause 5 (*c*) of the Admiralty Agreement, certain apparatus besides the articles mentioned in the schedule published by "Your Correspondent" on page 1032 of your issue of December 28th.

At any rate, if any responsible Admiralty official signs his name to a statement that what I have written over my signature on this subject is incorrect, he will be put in the position of being compelled publicly to withdraw what he has said, or of being shown to have made an incorrect state-

ment which, when proved incorrect, he has not had the decency to withdraw.

As the managing director of the company which made the contract with the Admiralty I am in a position to speak authoritatively as to the nature of that contract. I have spoken very emphatically as to its nature. If a representative of the Admiralty, over his own signature, will declare that my statements are incorrect, we shall have a fair issue. Meanwhile, in the absence of any such statement made by an Admiralty official, my statement has value and weight; whereas the statement of an anonymous correspondent is of even less value than that of any "man in the street" who has the courage to sign his own name to an assertion.

Marconi's Wireless Telegraph Co., Ltd.,
H. Cuthbert Hall, *Managing Director.*

London, E.C., *January 8th*, 1907.

Inquiries.—A correspondent wishes to know the date when the electric searchlight was first introduced into the Navy.

A correspondent seeks information regarding "Horn Fibre."

Several important letters have been received, too late for insertion.

LEGAL.

Wages Claim.

At Enfield Police Court on Monday, Thomas Ward, a director of the Electrical Instrument Manufacturing Co., who resides at Enfield, was summoned by Henry Ross, of East Dulwich, in respect of £6 8s. wages due. Complainant stated that he was engaged by a Mr. Helston, on behalf of Mr. Ward, as foreman of the latter's works. In the latter part of October and the early part of November some wages became due, and witness asked defendant for them. On one or two occasions defendant told him that he had no money, but at times he gave him small amounts. Once defendant told him to go to the works, and set the machinery in motion, as a Capt. Morris was coming to see the factory preparatory to considering a partnership in the business. On another occasion a railway official called. At length witness ceased work, as £6 8s. was due, which constituted the present claim. Defendant stated that he was a director in the company, who gave him permission to use the premises. A Mr. Helston brought out a patent in electric lamps, and witness agreed to finance him. He did so, but Helston did not carry out his part of the agreement. Helston engaged the complainant as his foreman, and witness gave him no authority to do so. The amounts that he paid the complainant were on behalf of Helston, to whom he had made advances. Witness gave the complainant some odd jobs, but he never promised to pay him wages arrears.

The Bench found in complainant's favour for £2 8s., &c.

Kelly *v.* Johannesburg Municipality.

In the Rand High Court last November, plaintiff, an electrician and a minor, sued by his mother to recover £5,000 for personal injuries received on March 5th last through the alleged negligence of the defendants or their servants. It appears that Kelly, who was in the employment of Messrs. Hubert Davies & Spain, electricians, of Johannesburg, was working at the Anglo-Austrian Buildings doing certain repairs in a room beneath the floor of which there was an electric transformer. Kelly slipped from the ladder and fell on the transformer, and was seriously injured.

Defendants in their plea denied that Kelly was doing these repairs. They also said that the transformer house was not erected by the municipality. They denied that the transformer house was dangerous, and they denied that it was the duty of the municipality to take all reasonable and proper precautions to prevent injury from the wires to persons legitimately on the premises. They denied that they were in any way guilty of negligence, and they further pleaded that Kelly was guilty of contributory negligence, in that he voluntarily and recklessly forced his way into the transformer house and failed to take any precautions to avoid coming in contact with the electric wires, which he knew were there.

After much evidence had been given, judgment was reserved.

Middlesex C.C. Electric Tramways.

At Wood Green Police Court on Friday there were six summonses against the Middlesex County Council, taken out at the instance of the Southgate Urban District Council for breaches of the Light Railway Order in connection with the construction of electric tramways at Southgate. The summonses alleged that the County authority did not complete three sections of the Green Lanes within four weeks from its being broken up; and, further, in three instances the authority broke up and opened the road in lengths exceeding a quarter of a mile.

Mr. Harry Godwin appeared for the U.D.C., and Mr. R. W. Harper was counsel for the Middlesex C.C.

At the outset the Chairman of the Bench (Mr. W. H. Rice) said that the magistrates were to a certain extent interested, inasmuch as they all resided in the county of Middlesex. If the Wood Green Bench could not deal with the case then no other magistrates in Middlesex could.

Mr. Harper: I am afraid that is the difficulty. The same thing applies to Quarter Sessions.

The Chairman: Are you willing to submit to our jurisdiction?

Mr. Harper: No, I cannot submit.

The Chairman: Apart from that, it appears to me that it is a great pity that two public bodies cannot come to some arrangement. It is not a case where the District Council would apply for penalties, I suppose?

Mr. Harper: I should be here two days telling you the details and going through the correspondence.

Mr. Godwin: I shall ask that the case be adjourned to enable me to find Middlesex magistrates paying rates in the County and residing outside, to hear it.

Mr. Harper: But you first need the jurisdiction to adjourn.

Mr. Godwin: You consented to an adjournment before, and it was granted.

Mr. Harper: I understand there is no reason why one section of the tramways should not be completed immediately; but as regards the other section, there is a real difficulty which I cannot go into now.

Mr. Godwin said the County Council were quite aware of that difficulty, and they should not have commenced the work.

On the suggestion of the Bench, there was a private consultation between the parties, after which they consented to the summonses being adjourned generally.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

New Galvanometers.

Amongst the apparatus shown by Mr. R. W. Paul, of Newton Avenue Works, New Southgate, N., at the recent exhibition of the Physical Society, were the two new instruments which are described below.

The first of these, shown in fig. 1, is Mr. A. Campbell's standard moving-coil galvanometer for all D.C. measurements, and for standardising ampere, volt and watt meters; several instruments of this type are in use at the National Physical Laboratory.

There are two sources of error in using the ordinary form of moving-coil galvanometer for such purposes: first, the fatigue of elasticity in the spring control, which causes a creeping of the reading after continuous deflection for a long period, together with an uncertainty of return to zero; and secondly, the presence of minute quantities of magnetic material in the coil, which in sensitive instruments produces a similar effect. The substitution in Mr. Campbell's form of galvanometer of a wide bifilar suspension (that

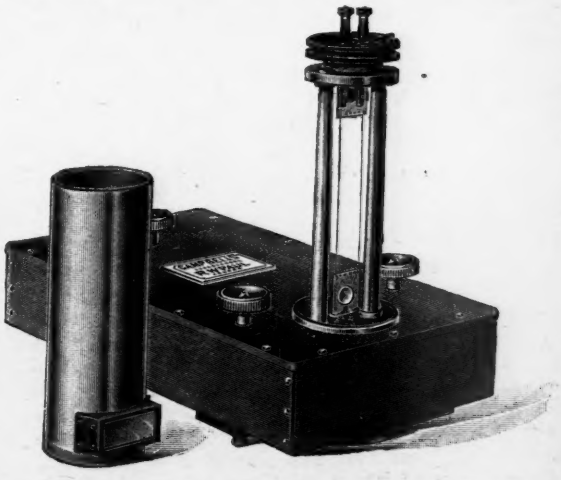


Fig. 1.—Campbell's Standard Galvanometer (Paul).

is to say, a gravity control) for the usual suspension strip has entirely eliminated the first difficulty, while the second has been overcome by the employment of comparatively large forces and low sensibility.

A very powerful compound permanent magnet is fitted with pole-pieces, and a fixed cylindrical core, the whole being covered by a suitable casing, and bolted to a substantial brass base-plate provided with large levelling screws. The intense field provides for the efficient damping of the coil, which is wound on a metallic former, and also allows of the required sensibility being obtained in spite of the strong control. The coil is of the Evershed form, suspended from an ebonite turntable, which, with the coil attached, may be readily lifted out of the instrument. The angular deflections of

the galvanometer are proportional to the current. The constancy of the zero is such that the coil may be left fully deflected for hours, or even days, without causing a zero creep of one part in 2,000.

Coil A (for current measurements) has a resistance of about 9 ohms, the total resistance of the instrument being about 12 ohms. The deflection given by ·0006 ampere is about 500 mm. at a scale distance of 1 metre, the distance apart of the bifilar wires being 13 mm. A swamping resistance of 143 ohms may be used when measuring a drop of ·1 volt on a current-carrying shunt, so that the temperature coefficient of the instrument as a millivoltmeter is less than ·03 per cent. per degree C. Coil B (for voltage measurement) has a resistance of about 35 ohms. Different sensibilities may be produced by varying the width of the bifilar suspension.

Fig. 2.—Paul's Moving-Coil Vibrationless Reflecting Galvanometer.

Fig. 2 shows a moving-coil vibrationless reflecting galvanometer, intended for use in places where the vibration is such as to render unsuitable an instrument with a freely-suspended coil; moreover, since it is provided with means for balancing the coil, it is particularly suitable for use at sea. A simple attachment enables it to be used as a convenient "speaking galvanometer."

The construction of the instrument, it is claimed, provides interchangeability of the suspended coils, which automatically make connection with the terminals when slipped into place; ready accessibility of the working parts; easy renewal of the suspensions if broken; a firm and reliable clamp for the coil, the engagement of which also releases the suspensions from strain, and other important advantages.

The magnet is of ring form, well aged, and is mounted on an ebonite base, which also carries the socket for the suspension tube. The terminals of the instrument are mounted on brackets below the base, with ample insulating surfaces. The whole of the working parts are exposed on removal of the cover, the lid of which is also separately removable, to give access to the top of the suspension tube.

The suspension tube, or coil support, consists of a stout brass tube, the lower end of which is accurately turned to fit the socket in the base, the tube being cut away to give access to the adjustments. The upper end of the tube is fitted with a rotating brass plug, which provides a coarse zero adjustment, and contains a plunger normally pressed upwards by a spiral spring, to tighten the suspension. By depressing the plunger, and giving it a slight turn to one side or the other, the strain is taken from the suspension; at the same time the coil-frame is locked against the core, which is a soft iron sphere, carefully centred to the bore of the magnet. The suspension strips are interchangeable, and are fitted with a pin at each end for convenience of attachment. Provision is made for balancing the moving system easily, without risk of breaking the suspension.

Coils of the stock pattern galvanometer are wound with 500 turns to a resistance of about 425 ohms. The damping is adjusted so that the spot comes to rest in one complete oscillation after deflection, and the periodic time is from 3½ to 4 seconds. The average deflection is between 60 and 70 mm. per micro-ampere at a scale distance of 1 metre. For reading signals through submarine cables, the damping is increased to render the action quite aperiodic.

The "Cantie" Patent Mining Switch.

The accompanying illustrations show a new mining switch made by the "Cantie" Switch Manufacturing Co., of 69, Mount Street, Nottingham. This is an exceptionally ingenious device; it is impossible to open the case (without taking out screws) unless the trick is known, and as the trick consists in pressing the switch-handle *backwards*, it is, of course, impossible to open the case without first switching off the circuit. Moreover, when the case is open, it is impossible to close the switch, and the handle has to be pressed back before the case can be closed. The cable terminals are of the plug and socket type, insulated with ebonite and enclosed in stout wooden plugs, which can be withdrawn from the case when the handle is pressed back, but not otherwise; in fig. 3 one of the plugs is shown separately.

The switch is of the double-pole type, on the "Cantie" principle; it ist herefore impossible to produce an arc with the switch,

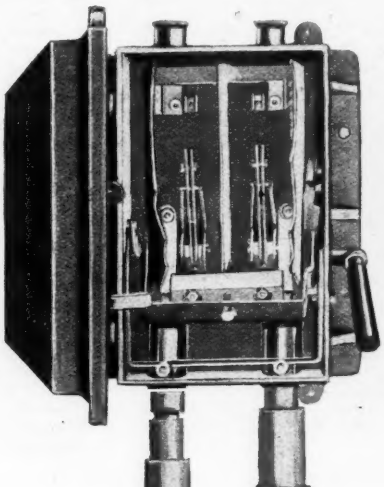


Fig. 3.—Case Open.

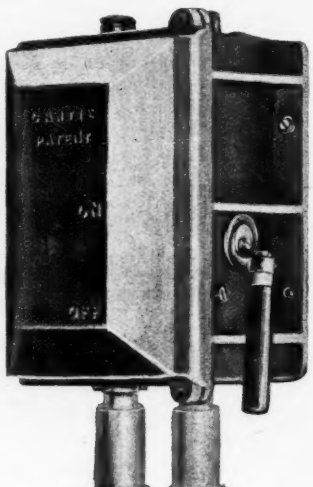


Fig. 4.—Case Closed.

The "Cantie" Mining Switch.

for the contact bars snap into as well as out of the contact jaws being in this respect out of the control of the user. The bars are also given a slight longitudinal rubbing motion whilst in the jaws, tending to clean the surfaces where cleanliness is of the greatest importance.

The whole of the conducting parts are thoroughly insulated from the case, the two poles being mounted also on separate bases; and the interior of the case is lined with mica, which is also used for a partition between the switches.

The case and cover are of cast-iron, of substantial dimensions, and strengthened with ribs; the leads are brought into the top of the case through stuffing-boxes provided with screwed glands, and the case is made watertight with a gasket laid in a groove in the cover. Lugs are provided to bolt the cover on if desired. The design of the switch is certainly interesting and workmanlike.

PROCEEDINGS OF INSTITUTIONS.

Practical Photometry and Its Value.

By Haydn Harrison, M.I.E.E.

(*Abstract of Paper read before the* Institution of Electrical Engineers *at Leeds, December 13th*, 1906.)

The best way to obtain a standard for practical purposes is to use an ordinary carbon lamp of low efficiency. This should be a lamp with a large, clear spherical bulb, and should be continuously run for about 200 hours, to get over the rise and fall in candle-power which occurs in the initial stages with nearly all carbon lamps. After that, it should be marked at a point on the cap, or glass, indicating the angle of the horizontal ray which it is intended to use for standardising purposes; in settling on the position of this mark, care should be taken that all the curves or twists of the filament are exposed as much as possible, and not covered by any other curve or twist, otherwise an alteration in the shape of the filament might considerably affect the candle-power in the position chosen. The lamp can then be sent to one, or several, of the well-known testing authorities to be tested. I found it a good plan to ask for a certificate stating the candle-power at the position marked, and the watts absorbed at a given voltage.

This lamp can be used to check sub-standards; it is a mistake to use it continuously, as, being a carbon lamp, it will change with running. On the other hand, sub-standards of much more permanent candle-power—such as the Osram lamp—can be kept in continuous use.

The choice of a sub-standard for continuous use depends on whether it is for general testing of any type of lamp, or for testing carbon lamps only. In the former case, I have found that an Osmium or Osram lamp on a small secondary battery circuit is much the most reliable and convenient. In the latter case, a carbon lamp of similar voltage is the most satisfactory, as the object attained in both cases is the same, namely, that, within

certain limits, the pressure across the standard lamp terminals does not need to be continuously measured and recorded. In fact, a low current lamp, having a positive temperature coefficient, connected to a comparatively large capacity secondary battery, is probably the most reliable light standard that has ever been produced.

A photometer intended for general use (which includes measuring the candle-power of lamps in position, and large candle-power lamps for which the ordinary photometer room and bench would

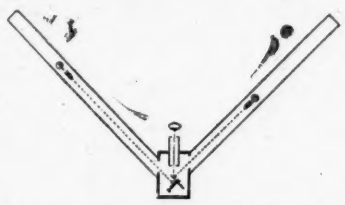


Fig. 1.—Plan of V-shaped Photometer Bench, Designed to Overcome Angular Errors.

not be sufficiently long) must necessarily be of the boxed-in pattern' in order that measurements may be made out of doors. A universal photometer of this pattern can be made sufficiently accurate for all practical purposes.

Instead of moving the standard lamp, the use of a diffusing screen having an angular movement, as described by Mr. A. P. Trotter, will be found a great advantage. My photometer, manufactured by Messrs. Elliott Bros., is made in this way.

The question of correct alignment is important with certain types of head, but this source of error may be eliminated by replacing the single photometer bench by two benches set at an angle, the photometer head being fixed at the apex, and the angle of the benches being such that the rays from both lamps would fall directly on their respective screens, thus eliminating error. The operator would sit between the benches; thus, not only would each bench be nearer his hands, but the lamps would be behind him. A diagram of this arrangement is shown in fig. 1. The whole arrangement, when used with the pneumatic flicker head which I have devised, forms a convenient, compact and accurate apparatus for rapidly testing lamps.

For use with a straight bench, the Bunsen disk photometer still remains, in my opinion, the most satisfactory arrangement for testing lamps of similar spectrums.

The principle of all flicker heads is the same, namely, to bring the surfaces illuminated by each source of light alternately before the eye. In the Whitman arrangement this is done by having one fixed screen, on which one light source shines, and

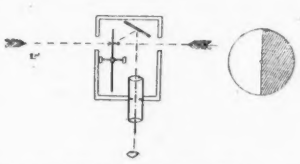


Fig. 2.—Lancelot Wild's Flicker Head and Rotating Screen, one side in shade.

one rotating sector disk, on which the other light shines at the time when it intercepts the view of the fixed screen. In the Simmance-Abady head the rotating disk is replaced by a solid block of dead white material, of which the periphery is turned up so as alternatively to bring before the eye surfaces illuminated from either source.

An arrangement devised by Mr. Lancelot Wild to eliminate angular errors is shown in fig. 2. It consists of a rotating disk, one-half of which is opaque and reflecting, the other half translucent and diffusing, constructed in the same way as the Bunsen disk. A part near the periphery of the disk is viewed by means of a mirror and telescope. Thus the advantages of the Bunsen disk are combined with those of a flicker photometer.

All flicker heads can be used as stationary heads by fixing the rotating part in the correct position. Therefore, except for the extra cost entailed by the mechanism necessary to rotate the head, they would probably be used in every case. In order to reduce this extra cost to a minimum, and to be able to rotate the disk at any desired speed without the bother of winding up clockwork and setting a speed governor, I devised a simple arrangement of rotating the moving screen by means of an air blast, produced by a compressible india-rubber bulb, or other suitable arrangement. If the rotating part turns freely, as is the case in the photometer made by Elliott Bros., not only can any desirable speed be obtained, but very little exertion is required on the part of the operator. Should the operator wish to have both hands free, he can use his lungs or a foot bellows for the purpose of maintaining the necessary blast.

If the instrument is only to be used, say, for testing or selecting large quantities of incandescent lamps, the V-shaped bench, permanently fixed in a dark room with non-reflecting walls, is probably the best arrangement. In this case, a good method of procedure is to put the standard lamp in the holder of the right-hand bench, the carriage being in a position equivalent to the certified candle-power of the lamp. A similar lamp of approximately the candle-power of the lamps to be tested is put in the holder on the carrier of the left-hand bench, and moved about until a balance is obtained; it is then clamped in this position, and the standard lamp is replaced consecutively by the lamps to be tested, each of which is moved about until the balance is obtained. Then, if the scale of the bench is direct-reading in candle-power, their candle-power in one direction will be indicated; and if the watts have been measured, a practical record of their value has been obtained.

A very neat and and compact arrangement for measuring the efficiency of incandescent lamps, and indicating the same in watts per candle-power, has been devised and patented by Messrs. Wilson and Hardingham, and is being manufactured by Messrs. Everett, Edgcumbe & Co. The general principle of this arrangement is as follows:—A variable resistance is connected in series with the shunt coil of the watt-meter in the circuit of the lamp to be tested; this resistance is in the form of a sliding rheostat, the lamp to be tested being attached to the slider. This is a boxed form of photometer, and the photometric balance with a previously tested lamp is obtained by sliding it backwards and forwards. The resistance of the rheostat is calibrated so as to increase or decrease the reading

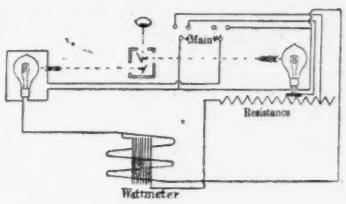


Fig. 3.—Wilson & Hardingham, Watts per c.p. Photometer

on the watt-meter in such a way as to make it read watts per candle-power. Contact keys are provided for reading watts consumed, should this be desired; and the candle-power can also be noted—thus making the instrument very valuable for this class of work. The general connections of the instrument are shown in fig. 3.

It has often been contended that tests which only indicate the candle-power in one direction are of little use, and that it is necessary to know the mean spherical and hemispherical candle-power. On the other hand, the knowledge of one of these is often equally useless, as it does not give any criterion of the position of maximum efficiency. The best method, in my opinion, is to take a sample lamp of the type you wish measured, and test it at various vertical and horizontal angles, in order that a curve of distribution may be plotted. Then, if the other lamps of that type be tested for candle-power in a known position, the approximate candle-powers in the other positions can be read off from the chart. This will be found a more satisfactory method than any other, when large numbers have to be rapidly tested.

As the above remarks refer more particularly to incandescent lamps, it might interest those who are in the habit of testing used lamps in order to ascertain if the time has arrived when they should be removed from the circuit, to know that the bulb blackening test, if properly carried out, can be relied on within very reasonable limits. It is doubtful, therefore, whether commercially a photometer is necessary for this.

A purpose for which photometers are, no doubt, commercially valuable, is to prove to prospective and existing consumers the value of electric lamps. As this has often to be done by means of comparison with gas already installed, an instrument which can be taken on the premises of a consumer and conveniently and rapidly used for the purpose, will often save the loss, or result in the gain, of a consumer, either by proving to him that he is using inefficient or old lamps, and, therefore, not obtaining full value for his money,

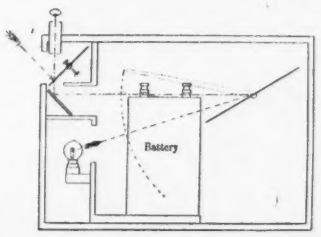


Fig. 4.—Harrison Universal Portable Photometer.

or by showing him that he is not deriving that degree of illumination which was promised by a rival if he used a certain means of lighting.

A portable photometer which can be used *in situ* for measuring any form of illumination is being manufactured by Messrs. Elliott Bros.

The general arrangement is given in fig. 4. The parts consist of a flicker head which includes:—A sector in the form of a disk driven by an air blast; a reflecting screen attached to a pointer, which gives it the necessary angular motion and indicates the angle; a mirror by which the degree of illumination of the screen can be observed through the telescope; a battery; a standard lamp; a plug key for connecting the standard lamp; and a sliding

resistance for adjusting the instrument, should the standard lamp change or a new one be required. A tripod stand is provided to bring the instrument to a convenient height for making the measurements. A spirit level, lens and quadrant, for ascertaining the angle of incidence of the light rays, are also provided. The total weight of the instrument is 18 lb. with the stand, 15 lb. without, and the dimensions, excluding the stand, are 13 in. by 9 in. by 6 in. The scale is calibrated direct in candle-feet. The distance between a point marked by a knob fixed in the side of the case and the lamp to be tested, if squared and multiplied by the reading in candle-feet, gives the candle-power of the lamp at that angle.

This instrument is very similar in design to that devised by Messrs. Preece and Trotter, with the exception that it is provided with a flicker head, and, therefore, is suitable for measuring light of any colour. The scale has a tenfold range when using one lamp only; but owing to the fact that the instrument can be used at any distance from the lamp to be measured, the candle-power of any lamp can be tested.

I have found the accuracy to be within 5 per cent., the only correction necessary being for the angle of incidence on the screen, which is indicated by the lens and quadrant. This correction need not generally be taken into consideration, if the angle does not exceed 25°; but the correction is scheduled on the scale, and, therefore, does not entail much trouble.

It only remains to consider how such an instrument can be made to benefit those who supply a commodity used for light-giving purposes. This I consider the commercial value of photometry.

Thus, when a consumer states that he is getting 70 c.p. for the consumption of 5 cb. ft. of gas per hour, the statement can be disproved by a photometer, and a satisfactory basis of negotiation arranged.

Another case is that of the consumer who complains of the light derived from incandescent electric lamps. If a representative is sent to him from the supply authority, with an instrument by which he is able to show that the lamps complained of are giving little light compared to others which have not been so long in use, the consumer will realise not only that he is to blame, but also that the supply authorities are prepared to give what they undertake, and to take trouble to show him the fact.

Every engineer of an electricity supply undertaking is keen to obtain the street lighting of his district, for well-known reasons. If the engineer is asked to tender, it is very generally for lamps of the candle-power stated to be given by the existing gas lamps, and he generally finds that he cannot afford to give this candle-power for the price obtainable. On the other hand, if the lamps were measured, they would probably be found to be giving only half that stated; in which case, the electrical engineer is being asked to give double what the gas company are giving for the same prices. I have had many instances of this kind, in several of which, by undertaking to give lamps of equal candle-power to that found to be the average of the existing ones, the electricity undertaking has obtained the public lighting, and carried it out to the satisfaction of all parties.

The competition between gas and electric lighting has reached a stage when slipshod methods of gauging their respective efficiency and cost should be done away with. Modern gas mantles have a very high initial candle-power, but this diminishes very rapidly. Therefore, if periodic photometric measurements are made *in situ*, it will be found that they are not the serious competitor which they are often imagined to be.

Discussion.

Mr. W. B. Woodhouse, in opening the discussion, said he would like to know what the percentage error was with a variation of the angle up to 25°.

Mr. James Jackson drew attention to the paragraph: "Thus when a consumer states that he is getting 70 c.p. for the consumption of 5 cb. ft. of gas per hour, the statement can be disproved by a photometer and a satisfactory basis of negotiation arranged." Personally, he had obtained with a consumption of 3·25 cb. ft. per hour with new mantles and clean globes, from 70 to 80 candles, or from 22 to 25 candles per foot. These were laboratory tests, but if they allowed 30 per cent. for depreciation, they would get something like 14 candles per cubic foot, a figure which Mr. Harrison had told them was not obtained under ordinary working conditions. Those who were interested in street lighting had been at great disadvantage in taking outside candle-power tests owing to the prohibitive cost of suitable apparatus. He inquired whether Mr. Harrison had obtained any tests on gas mantles 30° above and below the horizontal.

Mr. Mountain asked whether Mr. Harrison had carried out any tests in regard to colour effects, as it appeared to him that they would get some extraordinary differences when testing lamps of different colours.

Mr. G. D. Aspinall Parr said that the flicker head undoubtedly enabled a much more accurate result to be obtained between two sources of light than any other photometer head he knew of.

Mr. S. W. Cuttriss asked whether the instrument put forward by Mr. Harrison could be used for measuring incandescent lamps in an ordinary room; in such a case some corrections would have to be made for reflection from the walls. They sometimes wanted to know what the illumination in candle-feet was on a particular object. He would like Mr. Harrison to say whether, if they took the reading in his instrument, they got the actual candle-power of the illumination which they saw on paper held in a similar position.

Mr. S. D. Schofield said that during the last few weeks he had had a considerable quantity of lamps delivered, and out of the first four put on circuit, there were complaints regarding two. Although they were new lamps, they were actually worse than the very black lamps that had been replaced. As a result of the tests which were made, the lamps were found to be very bad indeed. The "man in the street" usually had the opinion that because the gas light was nearer his eye, he was getting a much better illumination than from an arc lamp placed considerably higher. He, therefore, thought the instrument which Mr. Harrison had described and shown to them would be very useful in ascertaining correctly the illumination.

Mr. Geo. Wilkinson said the Engineering Standards Committee had been at work for 18 months upon a specification with a view to standardising carbon filament lamps. That specification had passed the Committee, and had been submitted to the makers and accepted by them, and also by the Electrical Association and other bodies; in his opinion the only way to make the thing thoroughly useful in lighting areas, was for the lighting authorities to make themselves cognisant of and expert in the use of photometric apparatus. Some 12 months ago he set forth in skeleton form a scheme for the testing and certification of lamps; that scheme had been in operation for about 12 months in Harrogate. Every contractor in the district was under pledge to send all his lamps, before selling them, to the laboratory to be tested, and any that failed to stand the test were subsequently returned to the makers. Clearly printed notices were sent out from time to time advising customers not to buy from anybody but the local agents, and with one exception this had been effective in keeping at bay the casual traveller. The Harrogate testing scheme had resulted in the supply of good lamps to the consumers, and a reduction in their accounts, and it had ousted the Continental makers who previously supplied considerable quantities of inferior lamps in the district. They had in Harrogate a total of nearly 80,000 lamps on the mains, and during the 12 months they had tested close upon 18,000 lamps; the consequence was that their customers were not leaving them and going to the gas company; in numerous cases their account had been reduced, and a much better illuminant provided. He mentioned this to show the absolute necessity of taking up the question of photometry very seriously, and of getting their assistants trained in the use of the apparatus, because if they did not they would certainly continue to lose ground.

Mr. R. L. Acland (communicated): The majority of central station engineers had up to quite recently devoted practically all their energy to the reduction of generating costs; they were now, however, beginning to realise in the face of the fierce competition of gas, that they had to sell "light," and that they had not done all they could with the consumer both for his advantage and their own, when the service cable was put into his premises. They had taken for granted that the figures on the lamp bulbs were correct, and had done very little to verify them. In this respect the gas engineer had had a much better training. Let them, therefore, attack him with the weapon which he had been so long used to, and talk "candle-power" to a possible consumer.

Mr. Harrison, in reply, said he had practically got over the difficulty of correction for the angle of incidence on the fixed screen. He found that by using a certain class of rough paper the error over an angle of 30° was not greater than 4 per cent., and if the instrument came within 5 per cent. it would answer all practical purposes. Regarding the candle-power of the lamps which Mr. Jackson referred to, in laboratory tests he had sometimes found much the same results as Mr. Jackson, in the early stages. The figure which he gave in the paper read at Manchester of 10 c.p. per cubic foot, referred to tests taken when the mantles were in use under ordinary circumstances. He had a quantity of figures and curves of candle-power of gas mantles which showed that the candle-power at 20° above the horizontal was the maximum. The best method of testing at various angles was with a mirror arrangement and a fixed gas burner. With reference to the colour errors which Mr. Mountain anticipated, with the flicker head there was little trouble in this respect, as any intelligent man could use the instrument. He generally found that people readily got used to the instrument, after they had realised that they must make the balance quickly in order not to tire the eyes. With reference to Mr. Cuttriss's remarks as to whether the instrument could be used for measuring lamps in an ordinary room, the instrument in question was really an illumination photometer; the scale was in candle-feet, and if there was a black wall behind the lamps, the result, when multiplied by the distance squared, would give the candle-power in that direction. If the walls or surroundings were white, the illumination would be higher, and the effective candle-power in that direction greater than the nominal candle-power of the lamp. Light or colour (which was only light of different wave lengths) affected the optic nerve differently in proportion to the degree of its intensity. The effect on the brain of two different degrees of illumination brought before the optic nerve was what they called a flicker. Therefore, if they were producing equal effects on the optic nerve, they merged into each another, and did not produce a "flicker"—thus showing that they were equal, or balanced. If a blue produced the same effect on the optic nerve as green, it appeared all as one, showing that the illumination was equal, provided the speed at which the head was worked was not so great as not to allow time for the optic nerve to distinguish the difference in degree. He must congratulate Mr. Williamson on the effect of the photometric testing they had started at Harrogate. He thought the system a very good one.

Mr. Harrison afterwards gave some very interesting demonstrations on the subject of photometry.

The Heating Coefficient of Magnet Coils.

The following contribution to the discussion on this paper, by Mr. C. C. Hawkins, has come to hand:—In addition to the valuable data given by Mr. Lister, something might be added for coils divided into sections, with ventilating passages between them. Each coil was divided into, say, three sections with intervening air-gaps of ½ in., and the whole coil was separated from the pole by distance-pieces, so that air could freely pass radially inwards and upwards. The cross-area of each section was not far from square, or if anything, the radial depth was slightly greater than the axial height. The merits of the construction were that the inner end-connections could be so easily brought out, and a thin wrapping of tape gave perfect insulation; also the mean final rise of the coil was made to approach much more closely to the external surface rise, and the heating coefficient for the mean final rise, on the basis of calculation suggested by Mr. Lister, could be reduced with open dynamo coils to 700, or even as low as 600. One of the sections was conveniently confined to the series winding when the machine was compound-wound. Since almost all insulating materials were good heat insulators, thick insulating bobbins, such as those moulded from vulcan-asbest, had the disadvantage of raising the heating coefficient considerably, although they were of great convenience to the manufacturer in the process of winding. When they were used, it would be advisable to take only the external surface as the basis for cooling calculations. The rise of temperature of the external surface was rather indefinite, and liable to be affected by various secondary causes, but in the majority of specifications, it still remained the rise of temperature of the external surface, as measured by a thermometer, for which a limit was specified. It must therefore possess the greater interest to the designer so long as the acceptance or rejection of the machine depended upon it. In reference to *surface* rise, the figure for well-ventilated "sectionised" coils was reduced to about 465 to 400.

Power for Driving Mills.

In a paper read before the Paper-Makers' Association of Great Britain and Ireland last month, Mr. Tom Nuttall gave a number of interesting figures regarding the comparative cost of steam and water power for driving paper mills. A special feature of this class of work is the necessity of heat for drying the paper, which is economically derived from the exhaust steam from the main engines. A two-machine mill producing 1 ton of "sulphite printings" per hour requires a main driving condensing engine with an average load of 450 I.H.P.; a steam-driven electrical plant for driving the auxiliary machinery, with an average load of 100 I.H.P.; and two variable-speed and two constant-speed steam engines for the paper machines, averaging together 180 H.P. The hourly cost of running is given as follows:—

Main Engine.

Coal	2s. 9½d.
Oil, labour and repairs ...	1s. 4½d.
Interest and depreciation...	1s. 4d.
	5s. 6d.

Electrical Power Plant.

Coal	0s. 9½d.
Oil, labour, &c.	0s. 3½d.
Interest and depreciation...	0s. 5d.
	1s. 5½d.

In the case of the machine engines, the exhaust steam is used for drying the paper; the author has experimentally found that these engines absorb less than 6 per cent. of the heat passed through them, and on this basis he finds the hourly cost to be:—

Coal	0s. 3d.
Oil, labour, &c.	0s. 7d.
Interest and depreciation ...	0s. 4d.
	1s. 2d.

Particulars are given of the methods adopted to determine accurately the cost of drying the paper; the result was that 3·9 lb. of steam at a pressure averaging 8 lb. per sq. in. were used per lb. of paper produced, and in the mill to which the previous figures would apply, the hourly consumption would be 4 tons of steam, corresponding with ½ ton of coal, costing 4s.

For general heating the author estimates the coal consumption at 3 cwt. per hour, costing 1s. 2½d. The total cost per ton of paper is therefore:—

Coal	9s. 0½d.
Working expenses of power plant	2s. 2⅝d.
Interest and depreciation on power plant ...	2s. 1d.
	13s. 4½d.

In the case of water power, the mill would be electrically-driven throughout. The assumption is made that the cost per H.P.-year for interest and depreciation on capital outlay of power plant, and for working expenses, is 70s., or 0·117d. per H.P.-hour; this covers all costs including the installing of the motors. The savings which can be effected by substituting electric for steam power are noted, and the following particulars of hourly cost are given:—

Beating room, 360 H.P.; miscellaneous purposes, 100 H.P.; paper machines, 180 H.P.; total, 640 H.P., costing, at 0·117d., 6s. 3d. Drying the paper and miscellaneous heating cost, as before, 5s. 2½d., and working expenses, interest and depreciation of boiler plant 1s. 2d., making in all 12s. 7½d. Thus the water-driven mill has an advantage of 8⅝d. per ton of paper made, assuming that the cost of coal is the same in each case; but where water power is available, coal is usually costly, so that the water-driven mill has not the great advantage that is generally supposed.

The paper was reproduced in the *Paper-Makers' Circular* for December, 1906.

TRADE STATISTICS OF ARGENTINA FOR 1905.

The following figures showing the importation of electrical and other materials into the Argentine Republic in 1905 are taken from the recently issued Trade Statistics; the figures for 1904 have been added for purposes of comparison:—

	1904. Pesos.	1905. Pesos.
Insulators of Earthenware, Porcelain, &c.—		
From Germany	14,376	17,010
„ Belgium	2,082	3,894
„ France	289	1,259
„ United Kingdom	13,317	14,537
„ Other countries	818	1,505
Total	30,882	38,205
Glass Insulators.—		
From Austria-Hungary	53	18
„ United States	541	82
„ United Kingdom	661	3
„ Other countries	150	—
Total	1,405	103
Wire and Cable for transmitting Electric Current.—		
From Germany	453,046	651,100
„ Austria-Hungary	3,650	1,537
„ Belgium	803	6,624
„ United States	12,244	21,624
„ France	10,220	10,946
„ Italy	92,894	69,854
„ United Kingdom	88,831	167,626
„ Other countries	525	109
Total	662,213	929,420
Telephone Apparatus.—		
From Germany	5,380	10,183
„ Belgium	10,654	16,590
„ United Kingdom	2,023	4,026
„ Norway and Sweden ...	5,204	4,447
„ Switzerland	1,085	3,392
„ Other countries	761	275
Total	25,107	38,913
Electric Bells.—		
From Germany	5,083	7,369
„ United Kingdom	206	479
„ Other countries	463	214
Total	5,752	8,062
Carbons for Electric Lighting.—		
From Germany	14,417	21,949
„ United States	9,510	4,874
„ France	1,757	1,467
„ United Kingdom	130	1,237
„ Other countries	1,240	829
Total	27,054	30,356
Dynamos.—		
From Germany	21,561	42,725
„ United States	5,815	42,083
„ France	1,820	4,120
„ United Kingdom	25,465	8,688
„ Other countries	6,285	120
Total	60,946	97,736
Arc Lamps.—		
From Germany	25,222	38,330
„ United States	2,236	1,572
„ United Kingdom	6,128	4,991
„ Other countries	1,200	1,796
Total	34,786	46,689

	1904.	1905.
Incandescent Lamps.—	Pesos.	Pesos.
From Germany	56,376	71,072
„ Austria-Hungary	1,624	5,426
„ United States	29,426	10,604
„ United Kingdom	5,372	7,960
„ Other countries	6,476	5,762
Total	99,274	100,824
Materials for Electrical Apparatus.—		
From Germany	117,115	225,352
„ United States	28,686	74,119
„ France	22,624	49,372
„ Italy	32,423	51,021
„ United Kingdom	98,040	217,187
„ Other countries	5,207	3,762
Total	304,095	620,813
Materials for Telephones.—		
From Germany	1,343	1,041
„ Belgium	1,680	—
„ United Kingdom	123	2,978
„ Norway and Sweden ...	238	1,522
„ Other countries	40	734
Total	3,424	6,275
Materials for Telegraphs.—		
From Germany	831	1,586
„ United States	1,559	2,036
„ United Kingdom	27,827	24,924
„ Other countries	3,094	5,861
Total	33,311	34,407
Meters for Electrical Energy.—		
From Germany	25,200	36,492
„ United States	7,644	8,820
„ United Kingdom	7,788	10,272
„ Other countries	144	1,584
Total	40,776	57,168
Electric Batteries.—		
From Germany	No details.	1,219
„ United States ...		885
„ United Kingdom ...		1,697
„ Other countries ...		166
Total		3,967
Electric Fans.—		
From Germany	880	456
„ United States	1,460	7,672
„ Italy	6,000	11,016
„ United Kingdom	660	2,168
„ Other countries	320	424
Total	9,320	21,736
Tramway Materials.—		
From Germany	200,313	265,589
„ Belgium	52,540	385
„ United States	142 894	131,330
„ United Kingdom	103,610	158,009
„ Other countries	601	8,200
Total	499,958	563,513
Steel Rails.—		
From Germany	151,648	366,769
„ Belgium	1,520,721	596,616
„ United States	267,219	2,415,762*
„ France	25,280	400,280
„ United Kingdom	2,715,847	2,675,089
„ Other countries	25,975	—
Total	4,706,690	6,454,516

* The average per year for the previous five years was 242,908.

Boilers.—		
From Germany	10,872	17,260
„ United States	8,847	19,720
„ United Kingdom	118,158	193,099
„ France	839	12,300
„ Other countries	26,329	4,874
Total	165,045	247,253

	1904.	1905.
Motors (various).—	Pesos.	Pesos.
From Germany	109,673	127,841
„ United States	228,689	283,763
„ United Kingdom	123,854	207,082
„ Italy	74,619	44,973
„ Other countries	34,600	34,982
Total	571,435	698,641
Tramway Cars.—		
From Germany	10,000	17,000
„ United States	17,259	67,660
„ United Kingdom	29,630	383,787
Total	56,889	468,447

Of the above imports the following were the values of the several classes of goods admitted free of duty for public works, &c.:—

	1904.	1905.
	Pesos.	Pesos.
Insulators of earthenware, &c. ...	7,799	9,973
„ of glass	661	—
Wire and cable for transmitting electric current	29,591	88,510
Telephone apparatus	—	500
Electric bells	—	5
Carbons for electric lighting ...	248	1,284
Dynamos	13,558	29,566
Material for electrical apparatus	57,792	267,685
„ telephones ...	—	1,919
„ telegraphs... ...	12,217	13,333
„ tramways	380,440	550,155
Electric meters	12	3,264
Motors (various)	155,283	323,815
Steel rails	4,756,690	6,454,516

Note.—Peso = 4s.

BUSINESS NOTES.

Catalogues, Calendars and Lists.—The British Griffin Chilled Iron and Steel Co., Ltd., of 139, Cannon Street, E.C., has sent us a hanging wall calendar. A good stout card of roughly 13 in. × 20 in. has red monthly date slips, as well as a set of cards for changing every day. Illustrations appear of chilled castings made by the company, also steel tired and chilled iron wheels.

A large wall sheet calendar for 1907 has come to hand from Messrs. G. J. Edwards & Son, Ltd., leather belting manufacturers, oil merchants and mill furnishers. Beneath the very clearly printed and arranged date figures is a list of goods that are held in stock by the firm.

Messrs. W. T. Glover & Co., Ltd., of Salford, always hit upon something acceptable as a New Year's novelty. Once we got into the way of cleaning our editorial pipes by the aid of a Glover souvenir. This year the firm will enable trunk telephone-users, ourselves among them, to check the length of trunk conversations by means of a sand glass "Tell-Time," and to hasten the rate of talking accordingly.

We are again indebted to the British Electric Transformer Co., Ltd., of Hayes, Middlesex, for a beautifully bound copy of Whittaker's Almanack for the current year. A few prefatory pages are specially inserted by the company, giving information regarding the various engineering institutions, and setting out a list of many of the more prominent users of Berry transformers. Later on we find an inset showing eight process views of the different operations connected with the production of a complete transformer of this type.

Messrs. Wilson Hartnell & Co., Ltd., of Kirkstall Road, Leeds, have prepared for their friends a most acceptable wall calendar for the current year, its great feature being a choice reproduction, 9 in. × 14 in., in colours, from the painting by Lamasure, "The Old Oaks by the Roadside."

The Campbell Gas Engine Co., Ltd., wish us the compliments of the season, with a useful pocket-book and diary containing an accident insurance policy for our protection during 1907. The first few pages contain some particulars of the Campbell Co., its works and various branches, also its manufactures, including oil and gas engines, pumps, suction gas plants, &c.

Messrs. W. H. Palfreyman & Co., of 17, Goree Piazzas, Liverpool. Circulars relating to their rust preventive for bright metal surfaces.

Mr Carl Cordes, Magdeburg (London agents, Messrs. Fieber and Krack, Chiswell House, Finsbury Pavement, E.C.)—Circular giving particulars of "Cordine," a new insulating material, also a list relating to insulating compound for cables, impregnating black filling-in compound, and other specialities for electrical work.

The Royal Standard Electric Lamp Manufacturing Co., 4, Hart Street, New Oxford Street, W.C.—Illustrated and priced circular relating to Royal Standard incandescent lamps.

Messrs. Stegmann & Co., of Clapham Junction, have issued a calendar which is quite a work of art in its way, and would grace the walls of any electrical man's office or study. The excellent reproduction from a photograph of a statuary group of maidens fair in pleasing attitude quite compels one to forget that it is a calendar.

THE ROCKWELL ENGINEERING CO., New York.—A batch of illustrated catalogues, describing their fuel oil-burning appliances; annealing and hardening furnaces with oil-burning outfit; heating machines for annealing, hardening, &c.; rivet-heating furnaces; double chamber metal heating furnaces; also brazing, flue welding and pot furnaces.

Installation News is the title of a chatty little monthly published for the electrical contractor by, and in the interests of, SIMPLEX CONDUITS, LTD. It is a 16-pp. pamphlet in bright red covers, and is a well-produced publication of the publicity magazine order.

The GE SE patent flash apparatus which is being supplied by the GENERAL ELECTRIC SIGN AND ENGINEERING CO., LTD., of 15, Dufferin Street, E.C. (showrooms, 32, Featherstone Street, E.C.), as well as being made in the form of complete signs for shop-fronts, doorways, &c., is also easily adaptable for signs already in position or for fitting to user's own new signs. Particulars as to prices were given in the recently issued pamphlet of the company.

The STERLING TELEPHONE & ELECTRIC CO., London, E.C.—Several new illustrated leaflets relating to their "Twencen" household telephones, parlyphones, and "Hygienea" hand-combination instruments. Also a copy of pamphlet No. 122, giving good illustrations, and brief particulars, including a note of prices, of a range of their telephone instruments suitable for various requirements.

THE MORK PATENT PULLEY BLOCK CO., 42-44, Moor Lane, E.C.—Two booklets describing their pulley blocks. No. 3 M list gives particulars of their new "Mork" patent pulley block with releasing gear, which is claimed to be the only pulley block on the market in which the worm wheel may be permanently lifted out of gear, enabling the idle bottom block to be overhauled with the greatest speed, or allowing the tackle to be used like an ordinary gin block for lifting light loads. This block is also fitted with a patent friction brake of a simple and effective design for sustaining the load. Its main feature is a leather washer, and by substituting a thicker or thinner washer, the sustaining power of the brake may be increased or decreased. This is an important point where the blocks are only to be used for lowering. In the latter case, a thin washer is substituted for the thick one, and the loads may then be lowered quickly without having to pull at the hand chain. In this list some particulars and prices are also given of electric travelling blocks of compact design. Booklet No. 4 particularises the "Original" worm-geared pulley block with self-sustaining brake.

MESSRS. HOLT & WILLETTS, of Lion Works, Cradley Heath, have sent us a couple of their attractively-designed wall calendars with monthly date slips. One of the calendars depicts in colours an electrically-driven lift with its complete installation, the other an electric crane.

MESSRS. PLUTTE, SCHEELE & CO., London, E.C.—This firm being sole agents for Great Britain, Ireland and the Colonies, for the manufactures of the Deutsche Telephonwerke G.M.B.H., of Berlin, have placed before us a fully and finely illustrated catalogue of 84 pp. in which are descriptive particulars of their telephone apparatus and accessories, multiple switchboards, signalling and mining apparatus, telegraph and precision instruments, wires and cables, machine tools, and twist drills and projectile parts. The brochure was compiled for showing what was placed on exhibition at their stand at Milan last year, and on that account it may be regarded as a generally accurate survey of the specialities of the company. The introductory pages contain an illustrated account of the firm's development and growth.

A very neatly designed wall calendar has been received from the WESTERN ELECTRIC CO., of London and North Woolwich. In addition to a set of monthly date slips, there is also a small complete calendar for the year. The general design includes some excellent photographic views of Western Electric telephone instruments and cables.

MESSRS. G. MASSIOT BROWNE & CO., 108, Argyle Street, Glasgow.—New price sheet of "Henrion" arc lamp carbons, also one relating to silvered glass reflectors.

MESSRS. MERRYWEATHER & SONS, 63, Long Acre, W.C.—Postal card showing illustrations of a number of different methods employed for driving their patent "Hatfield" pump.

MESSRS. MAVOR & COULSON, LTD., Glasgow.—The January date-card gives a diagrammatic illustration, showing the rapid progress of the Pick-quick coal-cutters. In 1906, 74 per cent. of the machines ordered were for repeat orders.

MESSRS. BRUCE PEEBLES & CO., LTD., London, E.C.—Advance copy of pamphlet No. 20, giving a complete technical description of the characteristics and operation of the Peebles motor-converters (Peebles-Bragstad-La Cour patents). It is a well-produced publication, and in the course of its 24 pages it discusses past and present sub-station practice, describes the principle of the motor-converter, and the manner of starting, and proceeds to deal briefly with the design and construction of single-phase converters, traction, lighting and special converters. A diagram is given showing a Peebles motor-converter connected up for three-wire direct-current supply, and some comments on the relative advantages of the motor-converter as compared with rotary converters and motor-generators, follow. A list of the more important contracts for their converters brings up to the rear.

MESSRS. HODGSON WRIGHT & WOOD, Century Works, Pellon Lane, Halifax.—List 21, giving prices, weights and particulars of their multipolar protected and ventilated type motors.

MESSRS. ALFRED HERBERT, LTD., Coventry.—A well-arranged and finely-illustrated publication of 100 pages, in which descriptions appear of their horizontal and vertical milling machines, their installation, operations and attachments; milling cutters and tools, the equipment of milling machines, recording milling operation, and preparing work for milling, are among the matters treated, and there is also a table of cutting speeds.

MR. ALBERT E. MALLANDAIN, 51, Cheapside, E.C.—A useful wall calendar, each slip of which contains a monthly date table and a complete year's days. The calendar will be a constant reminder of the firm's drawing office specialities.

THE CHLORIDE ELECTRICAL STORAGE CO., LTD., of Victoria Street, S.W., will be constantly under our notice during the coming months, for they have sent us, as a New Year souvenir, an ebonite match-box with a Chloride battery plate moulded on one side and a wood separator, for which they are noted, on the other.

Canada.—Our Canadian correspondent writes that the CANADIAN WESTINGHOUSE CO. have been sharing to the full the general prosperity. The company are receiving large and important orders from all over Canada, and they themselves are not only surprised and gratified at the many orders which are pouring in, but at the high class of apparatus called for. It is a significant feature of the rapid development of Canada, and of Western Ontario in particular.

Large Crane Controllers.—THE ADAMS MANUFACTURING CO., LTD., send us news of the dispatch from their Bedford works, of three crane controllers, which they claim to be the largest automatic crane controllers ever installed in this country; they go to Craven Bros., crane-makers, of Manchester, but it is understood that their ultimate destination will be one of the largest steel works in Sheffield, where they will be used for handling with lightning rapidity, white-hot steel ingots weighing up to 120 tons. These mammoth crane controllers are for 325 H.P. Hitherto a 100-H.P. crane controller has been considered a very large size, and few even of this dimension have been installed, and it is believed that none of them was entirely automatic, while from 50 to 60 H.P. has been the average. The entire operation of these crane controllers is by means of a small master switch, which can be easily operated with one hand. This switch transmits through solenoid controlled contactors, which handle the main current between the supply circuit and the motors; the normal current handled by these switches would be about 1,200 amperes. The amount of current used for operating the contactor switches handling 1,200 amperes, does not exceed ½ ampere. The largest like apparatus supplied for crane or ship derricks, and controlled on similar lines were three 80-H.P. controllers recently supplied for operating large derricks in connection with shipyards in Japan.

Trade Announcements.—Mr. CHARLES PULLAN, electrical engineer, has removed from No. 57 to No. 52, King's Arcade, Bradford, where all communications should in future be addressed.

The telephone numbers of the West Ham Corporation Electricity Supply Department are as follows:—Office and Showroom, 84, Romford Road, Stratford, 1320 and 1321 East. Generating Station, Tucker Street, Canning Town, 865 East.

To meet increased business the AUTO-CLAW CO., LTD., have taken larger premises at 148-150, Curtain Road, E.C., where there is a floor-space of 8,000 sq. ft. Up-to-date machinery has been installed in order to cope with the demand. The removal of the works, offices and warehouse from Beech Street, Barbican, will be completed by January 15th, and the trade are asked to take note of the fact that after that date all communications should be sent to the new address. In addition to their well-known switch, &c., accessories, the company are now putting on the market certain new inventions and a range of bells—of course English made.

MESSRS. JESSON, BIRKETT & CO., LTD., of St. Dunstan Works, 7, Mary Ann Street, St. Paul's Square, Birmingham, have secured the services of Mr. Martin Muir (for many years associated with the Birmingham Guild of Handicraft) as their business manager.

Power-Gas Plant for Japan.—THE POWER-GAS CORPORATION, LTD., of Westminster and Stockton-on-Tees, have obtained the order for the power-gas installation for the Fuji Paper Mills, near Yokohama, Japan. The gas plant has a rated capacity of 3,000 I.H.P., and is designed to produce about 180,000 cb. ft. of gas per hour from local fuels. The whole of the gas will be specially cleaned and made suitable for use in gas engines. The installation consists of two producers of the Mond type, with special arrangements for cooling the gas. This is the second important gas-driven power station for the East; the first, of 6,000 H.P., for Hong Kong, has just been shipped, and the Corporation are making arrangements for commencing its erection. Amongst other important plants just completed by the Corporation there is the 6,000-H.P. installation for the Tranmere Bay Development Co., Ltd. (Messrs. Cammell Laird & Co.'s shipyard), Birkenhead, which included gas engines (over 1,600 H.P. total capacity), dynamos, &c., and was recently officially tested and handed over. They have also just started up the Mond plant for the Nostell Colliery, near Wakefield, and finished the erection of a similar plant for the Brodsworth Main Colliery Co., in South Yorkshire, both of which are to supply gas to gas engines.

Bankruptcy Proceedings.—A. A. ADAMS.—Under the failure of Alexander A. Adams, company director, &c., of Camomile Street Chambers, 36, Camomile Street, E.C., the adjourned first meeting of the creditors was held last Monday at the London Bankruptcy Court, before Mr. E. Leadam Hough, Senior Official Receiver. It transpired that some two years ago the debtor started a business under the name of the Electric Insurance and Contract Co., at 86, Leadenhall Street, E.C., and 23, Foubert's Place, Regent Street, W., intending to subsequently form the same into a limited company. Having, however, expended between £1,800 and £2,000 in developing the business and finding he was making too heavy a loss, he closed it four months ago when the landlord seized the stock and office effects. The debtor has acted as a director of

various companies, among the number being Durolite, Ltd. He returns the total liabilities at £7,505, of which £5,075 is expected to rank against net assets valued at £1,817 after deducting £98 for the preferential claims. The meeting was further adjourned for a fortnight to enable the debtor to lodge a composition offer.

The Dance of the Lamp-makers.—On Saturday, January 5th, the Social and Athletic Club in connection with Robertson Electric Lamps, Ltd., held their annual plain and fancy dress dance in the large dining hall at Brook Green Works, Hammersmith, W. The evening proceedings were a great success, nearly 400 members and friends being present. A large number of fancy dresses were in evidence, and prizes were awarded for the best fancy costumes. Mr. Wilson, the manager, in distributing the prizes, remarked that owing to the popularity of these dances, he regretted that arrangements had to be made to limit the number of visitors, and though at all times the firm were only too pleased to get the employés to bring their friends on these occasions, it must be borne in mind that the dining hall was built principally for the convenience and use of the employés of the Robertson Lamp Works. The dancing terminated at 12 o'clock, after a most successful evening.

Plant for Sale.—The Wolverhampton Electricity Committee is inviting offers for the purchase of a number of high-tension continuous-current generators and motor transformers, of which some particulars are given in our advertisement pages to-day.

Dissolutions and Liquidations. — General Contracts Co., Ltd.—Creditors are to send particulars of their debts, &c., to Mr. G. T. Feasey, 9, Old Jewry Chambers, E.C., the liquidator, by February 16th.

Graham Morton, Ltd.—A meeting is to be held at 1, East Parade, Leeds, on February 6th to hear an account of the winding up from the liquidator, Mr. R. Hilditch.

Moesch & Schmidt, manufacturers' agents, 43, Basinghall Street, E.C., and Brussels.—Messrs. H. J. Moesch and F. Schmidt have dissolved partnership. The former will attend to the Brussels debts and continue that branch of the business; and the latter will do the same in connection with the London business.

Bunney & Osborn, electricians and gas fitters, 4 and 6, York Road, Leicester.—Messrs. J. A. Bunney and R. W. Osborn have dissolved partnership. Mr. Osborn will attend to debts.

British Trade. — Judging from the recently-issued returns, British trade generally had a record year during 1906, the total imports and exports being nearly a thousand and sixty-nine millions. The imports were £607,987,893, an increase of £42,967,976 over 1905. The exports were £460,836,299 an increase of £53,239,772 over the 1905 figures.

Book Notices.—*Annuaire pour l'An* 1907. Paris: Gauthier-Villars. Price 1 fr. 50 c.—This handbook, which is very stout compared with its length and breadth, is issued yearly by the Bureau des Longitudes, the present being its 111th appearance. It contains detailed tables relating to weights, measures and coinage systems; geography and meteorology, and statistics. Physical and chemical data will appear in next year's issue. There is also a large astronomical section, and a number of special articles. The book contains a vast amount of information for the price.

Mitteilungen der Berliner Elektricitäts-Werke. — We have received a bound copy of this series for 1906 from the Editor; it is a highly decorative, and from some standpoints artistic, production, printed on art paper, with coloured illustrations. The parts are issued monthly, with a calendar for the month on the last page; the contents are of varied character, including general notes, examples of electric lighting, heating and motive power, and other matters likely to interest the public and to extend the use of electricity. Some beautiful views of interior lighting effects are given, and the half-tone views of apparatus, &c., are admirably executed. The variety of applications of electricity exemplified, and the attractive manner in which this periodical is produced, combine to render it a really excellent work, which we strongly commend to the notice of those engaged in the commercial development of electricity supply. In passing, we notice a reproduction of Mr. A. Hunt's picture of Dr. Gilbert showing his electrical experiments to Queen Elizabeth, accompanied by an appreciative biographical note on our gifted fellow-countryman.

Locomotives of 1906. By Chas. S. Lake. London: Percival Marshall & Co. Price 1s. net.—This is a book of some 40 pages, containing some excellent process blocks and leading particulars of the various types of steam locomotives turned out from the various shops in this country and abroad during 1906. A brief survey of modern locomotive practice is also given; one striking feature of 1906 is the adoption, by a number of the principal British railways, of the "Atlantic," or 4-4-2, and the 4-6-0 types. This well-known author on locomotive matters expresses the opinion that the displacement of the steam by the electric locomotive will be a very gradual one, and that railway companies are by no means over anxious to resort to electrical haulage. In order to increase the size and power of locomotives for suburban traffic, it becomes necessary either to employ locomotives with a greater number of coupled wheels, and thereby increase the rigid wheel base, or else to employ articulated locomotives. For this class of service, at any rate, the electric locomotive offers severe competition. Those interested in steam locomotives will find this little book entertaining.

"The Manufacture of Light." By Silvanus P. Thompson, D.Sc. London: Macmillan & Co., Ltd. 1906. Price 1s. net.

"Proceedings of the Rugby Engineering Society." Session 1905-6. Vol. III. Rugby: The Society. Price 10s. 6d.

"Science Examinations, 1906." Reports, &c. (Board of Education). London: Wyman & Sons, Ltd. 1906. Price 6d.

In the sixth number of *Concrete and Constructional Engineering* just issued, there is an article by Mr. W. N. Twelvetrees, M.I.Mech.E., dealing with reinforced concrete bridges in different parts of the world. The number also contains an illustrated article on the steel and concrete work at the Ritz Hotel, London.

"Proceedings of the American Society of Civil Engineers." Vol. XXXII, No. 10. December, 1906. New York: The Society.

"Proceedings of the Engineering Association of New South Wales." Vols. XII, XIII, XIV, 1897-9; Vols. XIX, XX, 1903-5. Also Act of Incorporation, Rules and By-Laws and List of Members. Sydney: The Association, 5, Elizabeth Street.

"Hilfsbuch für die Elektrotechnik." By Dr. Karl Strecker. Berlin: Julius Springer. 1907. Price M. 14.

"The Treatment of Storage Batteries." By R. W. Vicarey. London: The *Electric Accumulator*. 1907. Price 2s. 6d. net.

LIGHTING and POWER NOTES.

Accrington.—The L.G.B. has agreed to the Corporation's borrowing £12,000, repayable in 20 years, for additional electrical plant.

Bideford.—The U.D.C. has received a notification that the Mutual Electricity Supply Co., which intended applying for E.L. powers, does not at present propose to proceed with the application.

Birkdale.—A poll of the residents of Ainsdale is to be taken during January, with a view to ascertaining the number of householders who would probably become consumers if mains were laid in that district by the Birkdale Electric Supply Co. If the number is sufficient to warrant a supply, the Lighting Committee of the U.D.C. will request the company to extend its mains to Ainsdale.

Blackpool.—Reductions in the charges for energy for motive power purposes are recommended by the Electricity Committee, as well as in the day tariff for lighting, heating and cooking. At a meeting of the T.C. last week it was stated by Mr. Alderman Brodie that the Committee desired to encourage the use of electric radiators and heaters for household purposes. He did not think municipalities in this country were holding out inducements in that direction. The Committee's recommendations were agreed to.

Canada.—Toronto.—An official communication has been received by the City authorities from the Hydro-Electric Power Commission, in which the rates for domestic lighting under the proposed municipal system are given. The lighting rates for Toronto are estimated as follows:—Commercial lighting, 6 cents per KW.-hour; residential lighting, 5 cents per KW.-hour. The corresponding rates charged by the Toronto Electric Light Co. are:—12 cents per KW.-hour and 8 cents per KW.-hour respectively. The engineer to the Commission stated that if the City of Toronto wished to confine its activities to a simple distribution, the estimates could be reduced very much, and the rates made considerably lower.

Berlin.—In consequence of the constantly increasing demand for electrical energy in this industrial town, the municipal electric plant has become so heavily loaded that orders have been placed with the Canadian Westinghouse Co. for several additions to the plant.

Erindale.—The extensive plant of the Southern Light and Power Co. at Erindale has been sold to the Stark Telephone, Light and Power Co. for $47,500. The liquidators of the Southern Co. have been operating the property for some months past, in order that they might dispose of it as a running concern, but it was found that to complete the plant a lot of extra capital would have to be sunk, and eventually the whole concern was closed down. The Stark Co. is exceptionally situated with respect to its new purchase, which is in close proximity to its own plant.

Smith's Falls (Ont.).—Messrs. Frost & Wood, manufacturers of agricultural machinery and appliances, whose extensive works were recently destroyed by fire, have laid down a complete new plant, in which electricity plays a more prominent part. The electrical apparatus was purchased from the Canadian Westinghouse Co., and includes one 230-KW. and one 140-KW. 440-volt generator; one switchboard, and 17 induction motors, varying from 10 to 75 H.P.

Colchester.—Mr. H. R. Hooper conducted a L.G.B. inquiry a few days ago, into an application by the T.C. to borrow £11,000 for E.L. purposes. The loan applied for covers an excess expenditure of £1,553 on a former loan. The balance of the new loan, we believe, is for condensing plant, &c.

Continental Notes.—Germany.—The Berlin Electricity Works Co. has reached the utmost limit of the capacity of the plant at the existing generating stations, as was mentioned in this journal several weeks ago, and it has now been possible to arrive at a supplementary agreement with the municipal authorities whereby the company has been authorised to proceed with considerable extensions of the generating machinery. It is intended to make a fresh issue of capital in order to provide for the execution of the

work, and this is to take the form of £1,000,000 worth of 4½ per cent. cumulative preference shares redeemable at 104 per cent. One half of this capital is to be issued at once, and has been taken over by a banking syndicate which has undertaken to transfer £250,000 of the issue to the Allgemeine Co. in accordance with the rights possessed by the latter, and to offer the balance to the shareholders on the basis of one new preference share of £50 for each £300 worth of existing shares held. It is expected that the total additional expenditure up to 1915 will amount to £2,000,000, of which 60 per cent. will be incurred in the next three years. The new agreement provides that in the event of the municipal authorities exercising the right of purchase in 1915, of the undertaking in Berlin, but not of the works outside, the company shall, at the request of the town, supply electrical energy to the latter for five or ten years at the present net prices subject to the operation of a clause relating to the price of coal. The purchase price may be at the book value of the undertaking, which has already been largely written down, and has still to be depreciated at a fixed rate under the agreement, or at a valuation.

France.—The towns of Bourg, Villefranche and Mâçon are to be provided with a hydro-electric installation by means of two artificially constructed falls on the River Ain. The first fall, called the Chute de Cize, is the more important, and will be obtained by a weir of a maximum height of 5·50 m., the power station being fitted with six turbines of 550 h.p. each, with a fall of 8 m. at a speed of 250 r.p.m., and two 100-h.p. turbines, serving for excitation and lighting the works. The net capacity of this generating plant is 1,850 h.p. The second fall, the Chute de Granges, will be situated 5 kilometres above the first, and created by a weir giving a fall of 4 m. The station will be fitted with five 240-h.p. turbines, with a fall of 4·25 m. The Cize station will also have a steam plant to supplement the water power plant in the dry seasons of the year.

In view of the inability of the inferior product of the Rouchamp collieries to compete with that from collieries in the Departement du Nord and Westphalia, and the further prejudice to its use expected to arise from the projected hydro-electric station on the Doubs River, the Rouchamp Co. has decided to embark in a scheme of electrical generation and distribution, using its own product for generation purposes.

Spain.—La Société Hydraulique Asturienne is the name of a company which has just been formed at Schaerbeek, Brussels, with a capital of £260,000 to put down a water-power plant on the River Nalon (Asturias), for lighting and power purposes at Gijon.

Italy.—Under the title La Societa per l'Utilizzazione dei Combustibili Italiana, a company has just been formed in Milan with a capital of £12,000 to encourage the utilisation of the existing supplies of lignite and peat in Italy. It is proposed to establish large electricity generating stations in different parts of the country where fuel is available, gasifying the latter on the Mond system. The energy generated is to be distributed in the locality for lighting and power purposes. It is intended to erect the first plant in Tuscany, near the lake of Brentna, where a plentiful supply of peat is obtainable.

Darlington.—The T.C. has applied to the L.G.B. for a loan of £3,700 for the provision of a 500-kw. generating plant.

Dudley.—The T.C. has decided to charge small accumulators for motor-cars at the power station, at the following rates:—10-ampere accumulator, 8d.; 20, 1s.; 30, 1s. 4d.; 40, 1s. 8d.

Falkirk.—The Town Council has resolved to oppose the order being promoted by the Scottish Central Electric Power Co., and it has been agreed to join hands with the Grangemouth T.C. in the event of that body deciding to oppose the order.

Farnworth.—The U.D.C. is now offering special terms for the supply of electricity in bulk to mill-owners and other large power consumers in the Farnworth district. Important developments are promised.

Gillingham (Kent).—The T.C. has decided to supply energy for power to the Sharp's Green Cement Co. for five years at 1d. per unit, for a minimum of 150,000 units per annum. The estimated annual consumption by the company is 312,000 units.

Glasgow.—At a meeting of the Clyde Navigation Trustees on Tuesday, it was reported that the generating machinery at Clydebank Dock, the two hoists, the six cranes on the North Quay, and the capstans, were nearing completion, and would probably be available during February. The Committee has arranged to inspect the plant before it is officially reported on as being ready for traffic.

Halesowen.—It was announced at a meeting of the U.D.C. on January 3rd that the Council was in negotiation with a company for the transfer of the Council's E.L. and tramway orders.

Hawick.—Good progress was made by the Urban Electricity Supply Co.'s undertaking during the past year. The lamps connected increased from 24,551 to 33,524 equivalent 8 c.p. Included in this total is 635 h.p. in motors. The units generated in 1906 amounted to 712,324, an increase of 43 per cent. over the previous year. Among the consumers connected during the autumn was a spinning mill with 66 motors of a total of 142 h.p.

Hendon.—A proposal is made to transfer the E.L. order, 1899, to the Electric Supply Corporation. Messrs. Crompton & Co., who originally purchased the order from the Council, have now asked for the approval of the latter to the transfer.

Hounslow.—A L.G.B. inquiry was conducted on the 8th inst. respecting a loan of £3,000 for electric lighting purposes.

Leyton.—The U.D.C. has reduced the price of energy on the flat rate from 4½d. to 4d. per unit.

London.—The Metropolitan Area.—At the meeting of the Metropolitan Asylums Board on Saturday, the Asylums Committee reported having had under consideration the question of the electrical supply for lighting and power at the Tooting Bec Asylum. At present the institution is lighted by electricity generated on the premises, by gas engines worked from a Dowson gas plant. This was adopted on the recommendation of Messrs. Handcock & Dykes, who were appointed in April, 1898, as consulting electrical engineers. The system was recommended by the Works Committee after full investigation and inspection of a similar plant then in use. At that time no supply of electricity was obtainable from any outside source. Additional buildings at the asylum are now approaching completion, and the Committee desires to take some action to reduce the cost of electric lighting and power. The existing plant is working at full pressure, and if the whole of the institution is to be lighted by electricity generated at the institution, extra plant will be required, estimated by the engineer to cost £1,000, in addition to increased annual charges. The Committee expresses the opinion that the fumes from the Dowson gas plant are at times very offensive, and complaints of the nuisance caused have been received from occupiers and owners of houses adjoining the asylum. The Committee has been advised that the substitution of other motive power would not materially lessen existing working expenses. The County of London Electric Supply Co. has, after prolonged correspondence, offered to supply electricity to the whole of the asylum on the following terms:—(1) Energy for lighting at 2¼d. per unit and for power at 1d. per unit; (2) minimum annual consumption, lighting 95,000 units, power 50,000 units; the minimum for lighting to be reduced pending the completion of the new buildings to 85,000 units; (3) the contract to be for seven years subject to extension, at the option of the Managers, to 14 years; (4) use of existing plant to be discontinued, and the whole of the asylum requirements to be taken from the company's mains; (5) maximum demand 100 kw.; (6) the company to bear the whole cost of whatever alterations, &c., are required with the exception of the cost of altering the gas generating room, to adapt it for the motor-generator. (The company proposes to utilise the existing gas generating room and install a motor-generator at an estimated cost of £350 with a switchboard suitable for the altered conditions). The engineer has reported that the offer of the company was extremely favourable. The rate of consumption of electricity, including the children's home, at present is 158,000 units per annum distributed as follows:—Lighting, 94,000; power, 64,000. It is estimated that on completion of the additional buildings the lighting consumption will be increased to 105,000 units, the consumption for power probably remaining the same, and making a total of 169,000 units. Reviewing all the facts, the Committee stated that it was of opinion that steps should be taken without delay to discontinue generating electricity at the Asylum, and to enter into an agreement with the County of London Electric Supply Co. for a supply in accordance with the terms offered and it recommended that application be made to the L.G.B. for consent to the sale of the existing electrical plant. The recommendations have been agreed to.

Battersea.—A writ has been served on the Council at the suit of Graham, Morton & Co, Ltd., and R. Hilditch, liquidator of that company, claiming £1,132 for work done and materials supplied under the contract for the provision of coal-conveying plant at the generating station. An appearance has been entered on behalf of the Council. In consequence of applications having been made for the supply of energy for power purposes in the vicinity of York Road, aggregating over 400 kw., a new feeder cable is to be provided from the generating station to the corner of Starch Factory Road, at an estimated cost of £1,577.

Hammersmith.—An L.C.C. loan of £18,985 for E.L. purposes is to be taken up. Application is to be made for sanction to another loan of £5,320, which includes a sum of £2,750 for the purchase of land for a sub-station and cartage depôt at Scrub's Lane.

Southwark.—The London Electric Supply Corporation has again renewed its offer of March 21st last to supply the Council with the electricity required for lighting the public lamps at 1½d. per unit. The communication was referred to the General Purposes and E.L. Committees. The E.L. Committee has reported on the question of putting into force the powers for wiring consumers' premises conferred on the Council under Part 5 of the London County Council (General Powers) Act, 1906. The electrical engineer was of opinion that the powers should be exercised, opportunity would then be given to get consumers among small dwellings which would be remunerative. The engineer also suggested that with the introduction of free wiring, an alternative hire-purchase system might be adopted for large consumers who do not wish to incur a heavy capital outlay for installation purposes, but as it was primarily for the small consumer that free wiring had been introduced it would be advisable to limit the number of lamps wired free to six, and make it a condition that slot meters be used; also that in such cases the standard rate of 4d. per unit be charged, which would include lamp renewals except where breakages are due to carelessness. For large consumers or where the usual discounts are allowed, the alternative hire-purchase system should be enforced, covering a period of three years by agreement, each payment to include interest at the rate

of 5 per cent., plus 2½ per cent. for maintenance on the outstanding amount, with a payment of 25 per cent. of the estimated cost of the installation before the work is started, the remainder to be paid in quarterly instalments. The Committee proposed to let the free wiring work to contractors in lots of from 25 to 50 tenements at a time, or for certain periods. Such an arrangement would retain the contractor's assistance in getting other consumers, and would work in the interests of the undertaking. As to the cost of this method of lighting, the engineer estimates the total cost of supplying this class of consumer at 3d. per unit, which would work out at about ½d. per unit net profit. The Committee proposes to leave the question of hiring motors out in abeyance, to be dealt with as the necessity arises. The Committee decided (subject to the usual sanction) to take steps for giving effect to the wiring powers conferred on the B.C.

City.—We understand that the City of London Electric Lighting Co. has offered to prove the superiority of up-to-date electrical illumination by lighting Holborn Viaduct and a portion of Farringdon Street at a considerable reduction on the present cost per lamp per annum. The company has also offered to light the streets outside the Central Markets with flame arcs at £18 per lamp.

The *City Press* says that the Charing Cross, West End and City Co. is to be given a chance by the Corporation of showing an up-to-date method of lighting.

Marylebone.—Owing to a mishap at the generating station similar to that which occurred a week or so ago, the north side of Oxford Street was again put in darkness for a short time on the 4th inst. A flash-over took place on one machine, thus throwing the load over to the other machines in operation; this brought out all the circuit-breakers. It took about a quarter of an hour to synchronise up again and set matters right.

Islington.—As briefly stated a short time ago, the B.C. is to initiate a special inquiry into the financial position of its electric light undertaking. The Lighting Committee and the chairman of the Permanent Committees are to conduct the inquiry, with power to call in expert evidence, and pending their report the scheme to spend £21,000 on extending the arc lighting of the streets is to be suspended.

Lambton Collieries.—The Lambton Collieries, Ltd., have now put into operation the electrical installation with which they have had their collieries and works equipped. The installation forms one of the largest plant put down in connection with the working of collieries. All the pits, nine in number, have been connected, and electricity is to be used for lighting, hauling, pumping and coal-cutting, in addition to working the coke ovens. The supply is being drawn from the power station recently erected by the Durham Collieries Electric Supply Co., Ltd., at Philadelphia, near Houghton-le-Spring, the centre of the Lambton company's operations. The cables have been laid in the underground roads of the pits, right up to the face in some cases, for coal-cutting purposes. In other instances, where it is not deemed advisable to carry the cables right up to the face, owing to water and other reasons, the electricity operates the air compressors and compressed air will be used for the coal-cutters in place of electricity. The installation will also effect a reduction in the number of ponies used in the pits, electricity being applied to the working of small haulage motors, and also to the working of the main pumps with capacities equal to 1,000 gallons per minute. In three of the pits the main haulage engines are being worked by the electrical supply. The work roughly represents about 3,000 H.P. The installation of electricity for lighting purposes has caused the private gas works of the company to be discarded, and many villages, with their churches, chapels, schools, &c., have, in consequence, been compelled to adopt electricity in place of gas. The Lambton Colliery Co. firmly believe that this electrical equipment will effect considerable economies in the working of the pits, and will also increase the output.

Newark.—The local Electric Supply Co. has offered, if the Council's order is transferred, to supply energy for lighting within nine months at 7d. and 3d. per unit, or on a flat rate of 6d., with 2d. per unit for power, and to pay the Council reasonable costs and the expense of the transfer.

Stourbridge.—The U.D.C. has now approved the draft deed of transfer of the Council's provisional order for electric lighting to the Shropshire, Worcestershire and Staffordshire Electric Power Co.

Sutton Coldfield.—The T.C. has applied to the L.G.B. for a loan of £420 for the provision of mechanical stokers at the E.L. Works.

Wimbledon.—Chiefly as a protest against the L.C.C. electric supply scheme, the T.C. has refused the County Council information concerning its electricity undertaking, required by the County Council's statistical officer.

Windsor.—The Electrical Installation Co. has reduced the price of energy for outside shop lighting with arc lamps from 6d. to 4d. per unit.

Worcester.—The T.C. has decided to supply energy for power at 1d. per unit to the Royal Porcelain Works Co., who undertake to consume energy to the value of £600 during three years.

TRAMWAY and RAILWAY NOTES.

Aston.—Once again serious difficulties have arisen between the T.C. and the B.E.T. Co. in regard to the future working of the tramways within the borough, and there seems no immediate prospect of any settlement of the dispute. At a private meeting of the representatives of the Council and the B.E.T., the attitude of the latter company was expressed as follows:—"We have lost £10,000. We have a plant that has cost £11,000. We ask you to pay us that sum of £10,000, but, before doing so, we allow you to take interest, sinking fund, renewals and £1,250 which we have guaranteed you. We then ask you to pay us £11,000 for trams, less depreciation, the amount of that depreciation to be arrived at either by an inspection of the books showing what we have taken, or if that course is disagreed to, by arbitration." On being apprised of these terms, the Council instructed its representatives to inform the B.E.T. that it was prepared to take over the tramways at a valuation, but was not prepared to pay a penny towards the deficiency which had been incurred. Much acrimonious discussion followed, and at the close of a private sitting of the Council, which lasted nearly two hours, it was unanimously agreed:—"That in the opinion of this Council it is desirable that every facility should be afforded to the adjoining districts for running powers over the Aston Manor tramways upon fair and reasonable terms; that Aldermen Walter Evans and Smith be authorised to support this view on the Joint Tramways Working Committee; and that, in the event of any difference arising in the Committee, it be authorised and empowered to refer the question to a referee to be agreed upon, or, failing agreement, to be appointed by the B. of T., in accordance with the terms of the agreement dated June 9th, 1903."

Bradford.—From the Tramways and Light Railways Association's Official Circular for December we learn that the Corporation Tramways Committee has resolved to accept an offer of Raworth's Traction Patents, Ltd., to supply, free of charge, two regenerative equipments and all necessary apparatus for trial on the Corporation cars for a period of six months. The conditions are, that in the event of the equipment effecting a saving of 23 per cent. in current consumption and fulfilling other guarantees given by the firm, the Corporation shall purchase such equipments at the price of £350 each.

Burnley.—The T.C. has decided to experiment with a new and lighter car on Manchester Road section, which is very steep, the car to be propelled by two motors on patent radial trucks, instead of four as on the present cars.

Canada.—Hamilton.—In consequence of the recent strike several of the cars were so badly damaged that the service had to be restricted whilst necessary repairs were being carried out. Nails were put in the armatures, and the most vital parts of the cars otherwise damaged.

Toronto.—The municipality has issued a writ against the Toronto Railway Co. for unstated damages, the city claiming that the company is responsible for injury done to the water mains by electrolysis. The Court is also being asked to issue an injunction against the company, to compel it to take proper precautions to isolate the current so as to prevent any further damage.

Continental Notes.—Turkey.—An official order has been issued by the Government of Turkey extending the concession of the Société des Tramways de Constantinople, which would have expired in 1908, for a period of 75 years from that year, and authorising the construction of three new lines. In addition to this the company has been empowered to transform the tramways from horse to electric traction. The undertaking has formed the subject of severe competition for the concession, both Belgian and American firms having sought to obtain possession of the tramway privileges as from the date of expiration, but the prolongation granted to existing interests has finally settled the matter. The principal parties concerned with the tramways are the Schuckert and Continental Companies, of Nuremberg, and the Commerz Bank and Messrs. Warburg, of Hamburg, and the work of conversion is expected to be entrusted to the Siemens-Schuckert Works Co., of Berlin.

Germany.—The beginning of the end of the few short lengths of conduit electric tramways which exist in Berlin has apparently arrived, and the overhead trolley, already so extensively used in the German capital, promises to reign supreme at a future date. It appears that constant interruptions in the working of the conduit sections have taken place, notably at the Potsdamer Platz. The interference with traffic must have been serious, or the supervising authorities, who are always so difficult to move in connection with the granting of facilities to private enterprise, would not have given permission to the Grand Berlin Tramway Co. to remove the underground conduit at the busy Potsdamer Platz, and substitute the overhead trolley. The work of conversion is already proceeding, and on its completion a considerable reduction in the hindrance to traffic, which has indirectly affected other sections of the tramways disadvantageously, will be achieved. Simultaneously with this work, the company has been authorised to replace the underground conduit in front of the Charlottenburg royal castle, with the overhead trolley, and this transformation is also taking place at the present time. These alterations seem to suggest the ultimate abolition of the con-

duit system from the German capital. Shortly after these lines were written, information came to hand of further disturbances on conduit sections on January 2nd, in connection with the tramways over the Opern Platz and the Schloss Platz, and later in the evening at the Brandenburger Thor. It appears that the underground conduit on various lines was substituted for storage battery cars, which proved to be a complete failure during the severe winter of 1901-2, but the conduit system has not been much better than the accumulator cars, as the traffic in the busy parts of Berlin is exceedingly heavy, and the snow and frost have amply demonstrated the impracticability of the conduit system for the German capital, owing to short circuits and the burning-out of the cables supplying the underground conductors, and the sensitiveness of the electrically-worked switches, and of the ploughs. It is contended that no reconstruction would prevent breakdowns in the future, or obviate the damage caused to the plant at the sub-stations, and that as a consequence the abolition of the conduit system should be carried into effect on all the lines where it is at present in use.

Plans are being prepared in respect of an electric tramway between Rybnik and Pless.

ITALY.—The Direzione Generale of the Italian State Railways has, says the *Giornale dei Lavori Publici*, finished the more important projects for the application of electricity to the State lines, the following six being indicated:—Pontedecimo-Busalla, Savona-San Giuseppe-Ceva, Gallarate-Arona, Gallarate-Laveno-Luino, Milan-Lecco, and Bardonecchia-Modane. The construction of a storage reservoir at Morbegno, to utilise the power from the feeders of the Adda, will also allow of the extension of the application of electric traction to the lines Usmate-Bergamo and San Pietro-Lecco. It is the intention of the Government to give the utmost possible development to electric traction on the railways, and all demands for water rights now presented to the Ministry of Public Works are submitted to examination by the Railway Department with a view to securing the neccesary reserve for this object.

La Societé du Tramway et Chemin de Fer Electriques de Rome-Civita-Castellana et Viterbo, which already has in operation 54 kilometres of electric railway on the Westinghouse single-phase system, is about to construct a new line, 43 kilometres long, between Civita-Castellana and Viterbo, and has just made a new issue of share capital for the purpose.

DENMARK.—A Reuter telegram last week stated that all the men employed on the tramway services in Copenhagen struck work on the 2nd inst. in consequence of a wages dispute, the tramway traffic being entirely suspended.

The *Telegraph* correspondent states that the strike still continues. On Friday last the company tried to reopen traffic with a new staff, but some of the cars were attacked, and their windows broken. The company has again stopped the traffic, fearing street riots.

BELGIUM.—The Société des Chemins de Fer Economiques has secured the Government's approval of the scheme to convert the horse tramway from the Bourse to the Place St. Josse, Brussels, to electric traction.

Glasgow.—The returns of the Corporation Tramways for last week, ended January 5th, constitute a record. They amounted to £18,977, as against the previous record of £18,793 attained during the week ended September 29th last year.

Lincoln.—The Corporation does not seem to have experienced much difficulty in maintaining an efficient service of cars throughout the frost and snow during Christmas week. The Lorain system at Wolverhampton, as mentioned last week, was practically inoperative during that period, but though some irregularity in running happened at Lincoln, services were not discontinued on any day. The G.-B. Surface Contact Co. are to be congratulated upon the success of their system in the combat with the wintry weather recently experienced.

London.—G.N. AND CITY RAILWAY.—This line was unfortunate last week. Up to Friday last, we believe, a breakdown in the train service had not happened since the opening of the line. We are not aware of the exact cause of the breakdown, but one of the conductor rails became displaced for some distance, and had to be relaid. Traffic was suspended for about five hours. However, the G.N. and C. Co. holds the record for continuity of service without mishap.

G.N., PICCADILLY AND BROMPTON RAILWAY.—Much has appeared in the daily Press during the past week respecting this new line, and the large number of passengers that have availed themselves of the new travelling facilities offered, but the statements were not always correct. From our lay contemporaries, we learn that accelerated services are under consideration.

L.C.C.—The first electric car over the new section of the northern system was run on the night of the 7th inst. from Aldgate to Bloomsbury. This is the continuation of the Poplar and Aldgate line. We understand that the B. of T. inspection took place on Saturday last, and it was expected that on Monday the horse cars would be superseded.

Luton.—The T.C. has asked Messrs. J. G. White & Co., Ltd., if they are disposed to consider the question of constructing, equipping and working electric tramways in the borough under the Council's order.

Nelson.—The Tramways Committee has resolved, in lieu of suspension for minor accidents and irregularities on the part of drivers and conductors, to award marks of merit or demerit, as the case may be, and that a bonus not exceeding 12s. be paid half-yearly to all drivers and conductors who have carried out the regulations applicable to their work, and by the exercise of care and skill have avoided accidents.

Potteries.—The Potteries Electric Traction Co., Ltd., has applied to the B. of T. for an extension of time until February 6th, 1910, for completing the Light Railways Extension Order, 1902, and also for the abandonment of the line between Catcham's Corner and the terminus.

Rawtenstall.—At a special meeting on the 3rd inst., the T.C. unanimously decided to promote a Bill to raise £223,200 for tramway purposes, for the construction of tramways in Bacup, Haslingden and Rawtenstall, and for electrifying the same.

Rochdale.—The T.C. has applied for a loan of £35,023 for tramway purposes.

Southgate.—The U.D.C. has obtained six summonses against the Middlesex C.C. for alleged contraventions under the Light Railways Order. Electric tramways are being laid through the Southgate district, and it is alleged that the county authority has opened greater lengths than that specified under the order.

South Lancashire.—A conference between the Swinton and Pendlebury U.D.C. and the South Lancashire Tramway Co. has resulted in an agreement, under which the company will construct a short length of track (about 200 yards) near the Clifton boundary, and take it on lease from the Council for a period of 30 years. The lease will run concurrently with the company's lease of the Clifton tramway. The new track will not actually join up with the Salford Corporation's system; the agreement provides that a space of 1 yard shall separate the respective termini. Should the company desire at any time to obtain running powers, a fresh agreement with the Swinton and Pendlebury authority will be necessary.

U.S.A.—The *Times* last week stated that Mr. Hughes, the Governor of New York State, in a message to the State Legislature, recommended as a measure for the relief of the crowded conditions of traffic in Greater New York, the abolition of the present board of Rapid Transit Commissioners and the creation of a new board with increased powers. The new body should be authorised to act on its own initiative as well as upon complaints, and should have power to supervise matters generally, to safeguard public interests and secure the fulfilment of public obligations by the transport corporations.

Wednesbury.—The Corporation has now consented to the running of the cars of the Walsall Corporation over the tramways within the borough, which consent is to be subject to withdrawal by the Corporation of Wednesbury at any time upon giving six months' notice in writing to the Corporation of Walsall and to the South Staffordshire Tramways (Lessee) Co., Ltd. With respect to the reconstruction of the Tipton section of the tramways, it has been decided by the Wednesbury Corporation that a clerk of works be engaged by the Corporation at the expense of the South Staffordshire (Lessee) Co., to superintend the reconstruction and re-equipment of the line from the Dartmouth Arms to the Tipton boundary.

York.—At a meeting of the City Council on the 7th inst., the Tramways Committee recommended the Council to refuse its consent to the promoters of the York and District Tramways Bill, 1907, laying down any tramways in the city, and that, if necessary, a memorial be lodged in Parliament complaining of non-compliance with Standing Orders. The Committee has agreed, subject to the approval of the Council, to purchase the existing undertaking of the City of York Tramway Co., at the price of £11,000. The purchase of the whole undertaking includes a small portion which is outside the city boundary. The company is to work the tramways until the Corporation has obtained powers to do so, and during such period to maintain the tramways, rolling stock, &c. The purchase money is to be paid on July 18th, 1909, the date when the company's lease terminates, or within three months after the date upon which the Corporation shall have obtained powers to work the tramways, or to re-construct, or to work the same as light railways, as the case may be, whichever date shall first happen. The Committee recommends that powers be sought to lay down a system of tramways within the city, and outside the city if desired, and then, if thought desirable, to negotiate with the promoters of the Bill now before Parliament, or other companies, for the leasing of the same. The report was carried by a large majority.

TELEGRAPH and TELEPHONE NOTES.

Canada.—Arrangements are being made by the Public Works Department of the Alberta Government for the construction of a public telephone line between Edmonton and Lloydminster. Specifications have been completed and the men chosen, and the Government is now advertising for tenders for the supply of the requisite material. Starting from Edmonton the trunk line will follow the general direction of the Canadian Northern Railway. Every town on the railroad between Edmonton and Lloydminster will be connected with the system, and later on inland towns will be connected by branch lines.

(Continued on page 67.)

THE ST. DENIS POWER STATION, PARIS.

One of the most up-to-date electrical generating stations as yet built on the Continent, is that of the Société d'Electricité of Paris, situated at St. Denis, on the outskirts of the city. The great development which is taking place in the use of electrical energy in Paris and its vicinity called for a modern power plant, capable of systematic extension and high efficiency in operation, and the St. Denis plant, of which only the first portion has been installed, promises with its 12 6,000-kw. turbine units, and its modern coal-handling and boiler installations, to fulfil these conditions. The plant is largely utilised for supplying the Metropolitan Railway in bulk, supplementing the existing 20,000-h.p. power station at Bercy, also for supplying certain of the Parisian Secteurs for lighting and power, and certain tramway undertakings.

In view of the fact that the Metropolitan Railway sub-stations were large immediate consumers of energy, the first four generators were installed for supplying three-phase current at 10,250 volts pressure and 25 cycles; two further similar sized units are to supply two-phase current at 12,300 volts pressure and $41\frac{2}{3}$ cycles, to the city secteurs, while plant is provided for supplying direct current at 230 and 550 volts for station purposes and for running tramways in the neighbourhood of the station.

The buildings, the arrangement of which will be gathered from figs. 1, 2 and 11, comprise an engine room, some 65 ft. in width, with an adjoining four-storied switch building on one side, and three double boiler houses are to be built out at right angles on the opposite side, while beyond each boiler house will be a coal storage building.

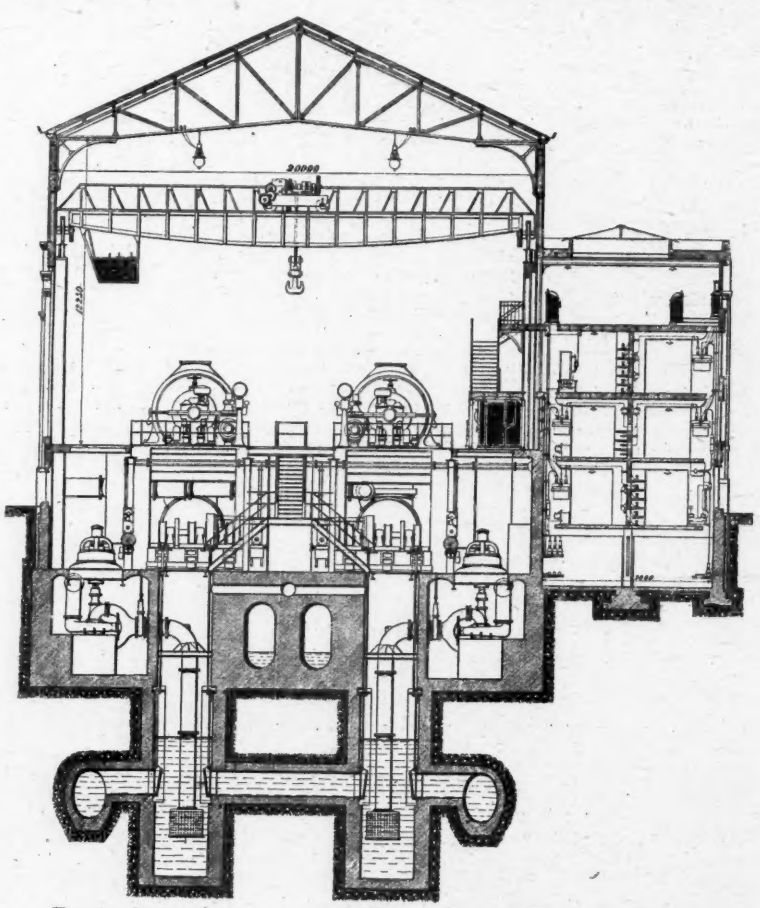


Fig. 1.—Cross-section through Engine and Switch Rooms, St. Denis Power Station.

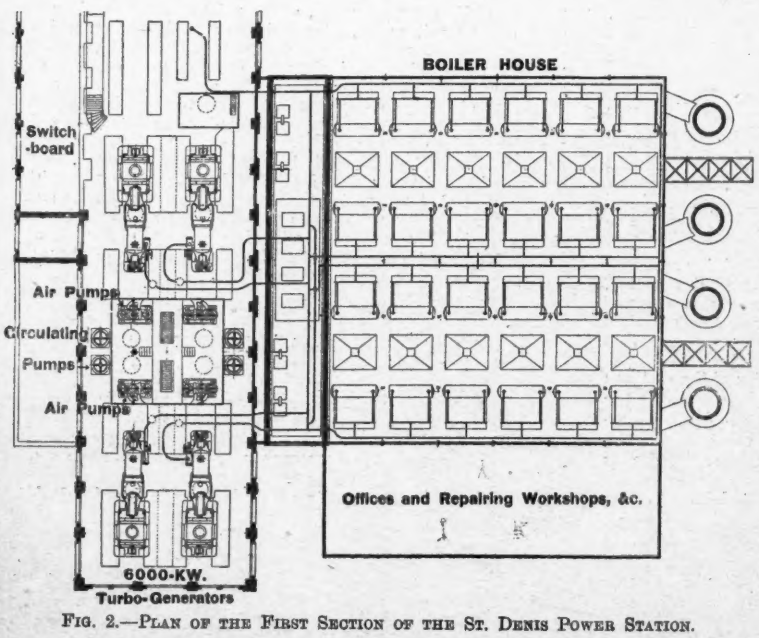


Fig. 2.—Plan of the First Section of the St. Denis Power Station.

Fuel is brought to the station in barges on the Seine, but the Nord Railway system is also linked up to the plant.

A wharf has been constructed on the river, and an electric crane transfers coal from the barges to a horizontal belt conveyor, with a capacity of 80 tons per hour, running parallel to the wharf and emptying into the hopper of another conveyor. The latter is of the Hunt endless bucket type, and arranged to be duplicated; it runs in an overhead covered structure in a direction at right angles to the wharf, passing across the ends of the coal storage buildings between the latter and the boiler houses, and is driven by two 10-h.p. 220-volt motors.

For the supply of each boiler house and coal storage, similar bucket conveyer systems are installed at right angles to the above-mentioned conveyor and fed from it. Thus each coal storage conveyor is arranged to pass over and fill the coal bins, and in returning underneath the latter to take in a supply of coal for the boiler house from spouts under the bins, which supply is transferred at the end of the building to the adjoining boiler house conveyor. The latter follows the usual arrangement, supplying on its inward journey a number of separate overhead coal bunkers, each arranged to feed by gravity, two facing boilers; and on its return journey under the firing floor, carrying ashes to suitable ash storage pits situated at the end of the coal storage buildings, for removal

by carts or by conveyor to river barges. Each of the secondary conveyors is driven by a 7-H.P. 220-volt motor.

Before transference to the boilers the coal is crushed to suitable size and automatically weighed. The coal storage as a whole will have a capacity of some 4,000 tons.

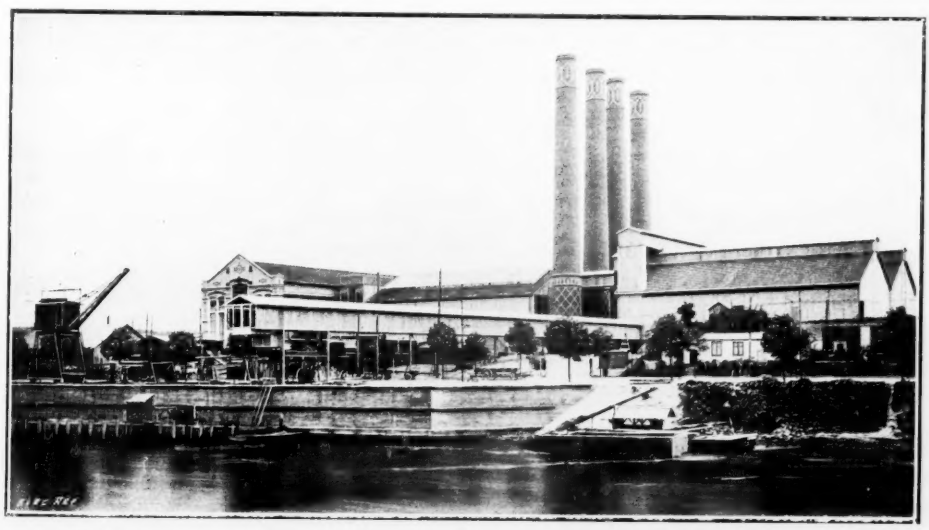


Fig. 3.—Exterior of St. Denis Power Station.

As previously mentioned, each boiler house is a double building containing 24 marine type Babcock & Wilcox boilers arranged in four batteries, pairs of batteries facing each other, as shown in fig. 4. Each boiler has a rated evaporation of some 20,000 lb. of steam per hour, and contains 33 sections of 14 tubes each.

Two chain grates are provided to each boiler, the ashes from which are discharged into a pit below, for transference to the conveyor; the grates of each battery of boilers are operated by a 12-H.P. motor.

The products of combustion from each boiler pass up through two superheaters of the same firm's make, arranged to add some 350° C. of superheat to the steam, and through a Green economiser of 160 tubes, arranged beside the main flue on a floor above the boilers; the main flue from each battery of boilers terminates in a Firbeck chimney at the end of the building, some 180 ft. high and 35 sq. ft. in area. Electrically-operated dampers in the flues are provided for draught and temperature regulation, and the latter can be determined by suitable gauges.

Between the boiler and engine rooms is situated a pump building, with four storage tanks in the basement and two feed tanks located in an upper storey.

Four electrically-driven pumps (two three-throw and two centrifugal) are installed for boiler feeding, the hotwell return from the turbines together with a proportion of filtered Seine water being utilised for this purpose.

Each pump is driven by an 80-H.P. D.C. motor, and the water for each boiler house is metered in the pump room.

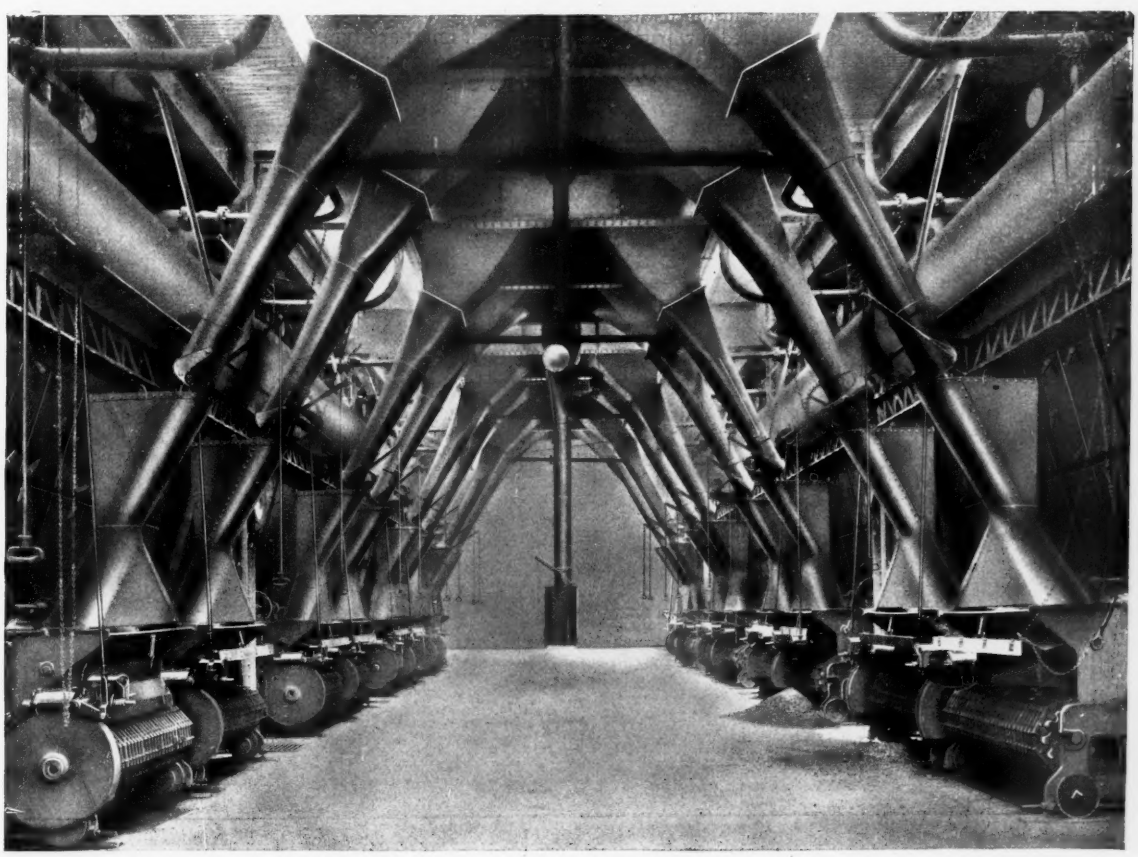


Fig. 4.—Interior of One of the Boiler Houses, St. Denis.

Steam from each battery of boilers is collected in a header running behind the boilers, which feeds a main header in the pump room; from the latter a branch feeds each turbine unit in the engine house, as shown in fig. 2.

The first turbine installation (fed from 24 boilers) includes a group of four 6,000-KW. Brown-Boveri three-phase units, and a smaller 300-KW. direct-current unit by the same firm, arranged with their axes along the building (fig. 5).

The turbines are of the Parsons type, as developed by Messrs. Brown, Boveri; the large ones are each some 47 ft. long, 14 ft. wide and 11 ft. high overall, and are guaranteed to consume not more than 15 lb. of steam per KW.-hour at full load, and 18½ lb. at half load, with steam at 177 lb. per sq. in. and superheated to 300° C.

Both turbine and generator are mounted on a heavy base-plate resting (not bolted) upon massive concrete foundations; the turbines are fitted with both ordinary and emergency "excess speed" governors, and provided with forced oil lubrication to the bearings—special steam-driven oil pumps being installed in the pump room for starting up, supplemented by pumps on the turbines themselves. A 6,000-KW. unit is shown in fig. 6.

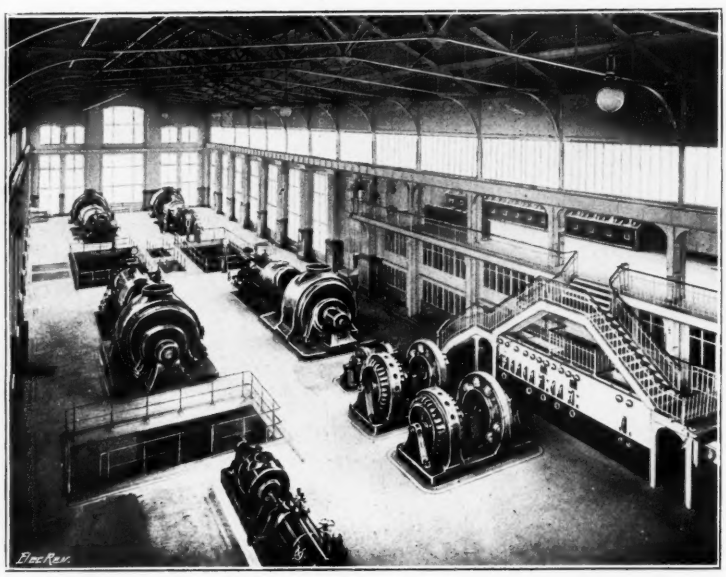


FIG. 5.—VIEW IN THE ENGINE ROOM, SHOWING GROUP OF 6,000-KW. TURBO-GENERATORS.

The generators are of the ironclad type favoured by the makers, and generate three-phase current at 10,250 volts pressure and 25 cycles, with a speed of 750 R.P.M.

The smaller 300-KW. unit, with its direct-current generator, has an output of 1,360 amperes at 230 volts pressure, with a speed of 2,700 R.P.M. All the turbines exhaust direct into surface condensers situated in the basement below. The circulating water in each case is drawn from a deep well, below the basement, the whole series of wells being interconnected and in communication with two oval tunnels running into the Seine. Beside each well is mounted a centrifugal pump, with a vertical shaft, coupling it to a 130-H.P. eight-pole Brown-Boveri motor with a speed of 310 R.P.M., in the basement, fig. 9; the circulating discharge from the condenser passes into two other tunnels running at a higher level under the centre of the basement, and discharging into the Seine. The air pumps are of the motor-driven three-throw pattern, as shown in fig. 10, a 30-H.P., 10-pole Brown-Boveri motor with a speed of 225 R.P.M. being mounted between two of the cranks.

The circulating and air pumps, and the deep wells for each group of four large turbines are arranged in proximity to each other, and are visible from the engine room through railed apertures in the floor. The condensing plant for the smaller turbine is of similar type; all the condensing plant was supplied by Messrs. Brown, Boveri.

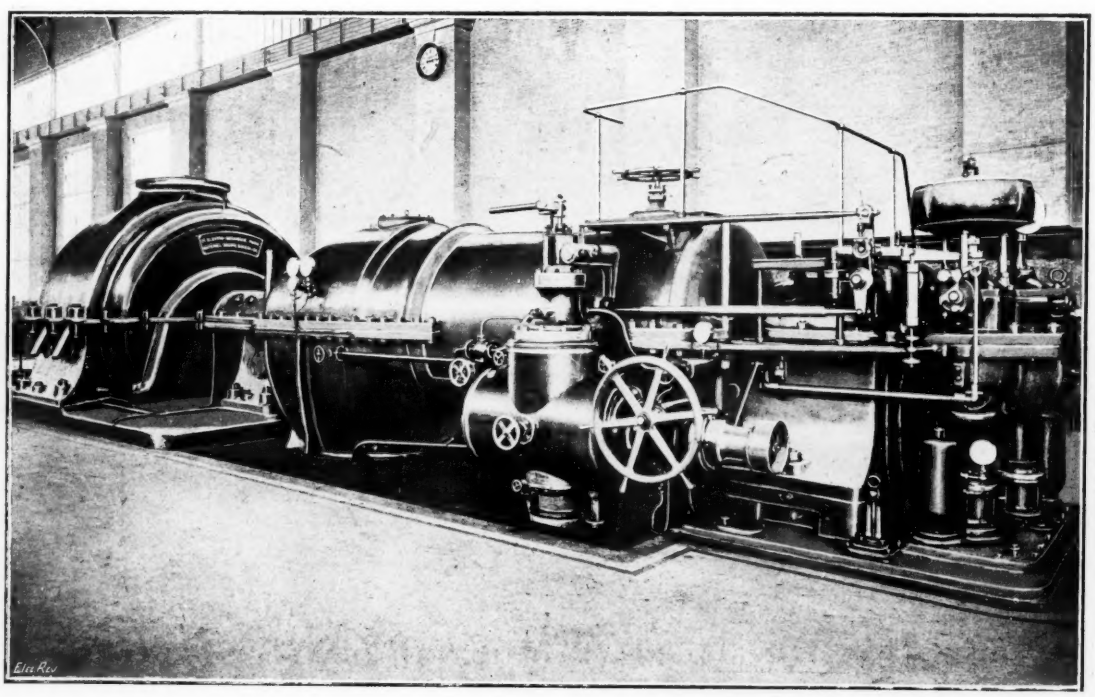


FIG. 6.—BROWN, BOVERI-PARSONS 6,000-KW. TURBO-ALTERNATOR.

The smaller 300-KW. turbo-generator was installed for excitation purposes when starting up the large units, and for supplying energy for operating the station lighting and motors. When running, however, this is provided for by motor-generator sets, three of which are installed, each of 375 KW. capacity. The motor is in each case a 10,250-volt three-phase 25-cycle asynchronous motor, with a speed of

375 R.P.M., run from the H.T. bus-bars, and coupled direct to an eight-pole direct-current generator, giving 1,700 amperes at 225 volts —the local station pressure.

These generators are connected in parallel to a 126-cell Tudor battery installed in one end of the switch building, and having a 1,300 ampere-hour discharge at the one-hour rate.

In connection with the latter, a 660-ampere 110-volt booster set, consisting of two six-pole machines coupled together, is installed for charging purposes.

A further somewhat unusual motor-generator set, consisting of four machines coupled together, is provided for dealing with other classes of supply, which will eventually be undertaken by steam-driven plant. This "polymorphic" set consists of two 500-volt direct-current generators, between which are mounted a 10,250-volt 25-cycle three-phase motor and a 6,000-volt 42-cycle two-phase generator coupled

Fig. 7.—The Control Switch Gallery Overlooking the Engine Room.

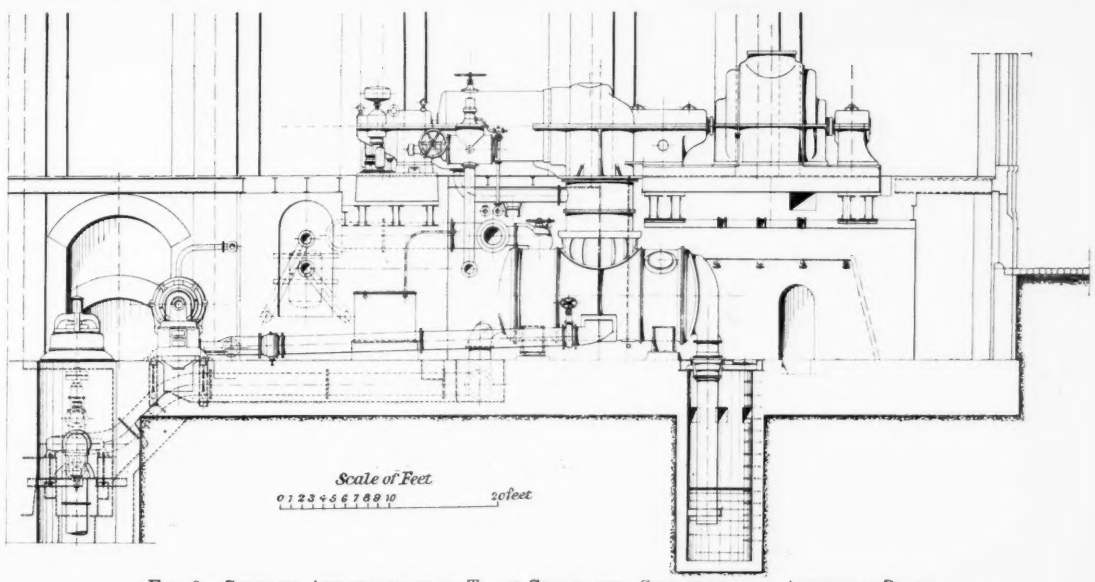


Fig. 8.—Showing Arrangement of Turbo-Generator, Condenser and Auxiliary Plant.

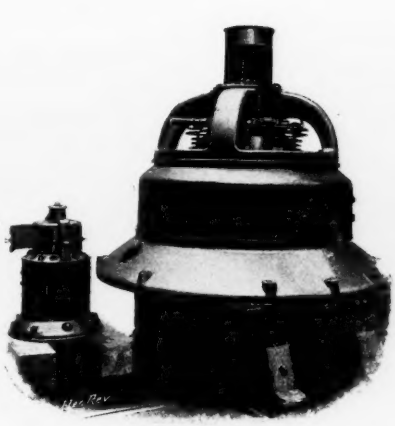


Fig. 9.—Vertical Shaft Motors for Circulating Pumps.

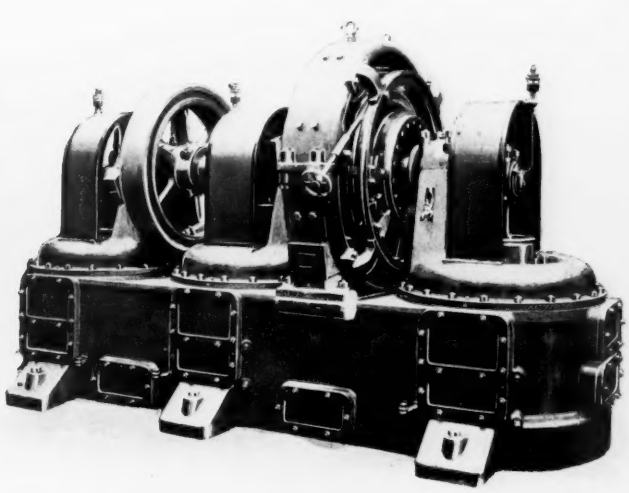
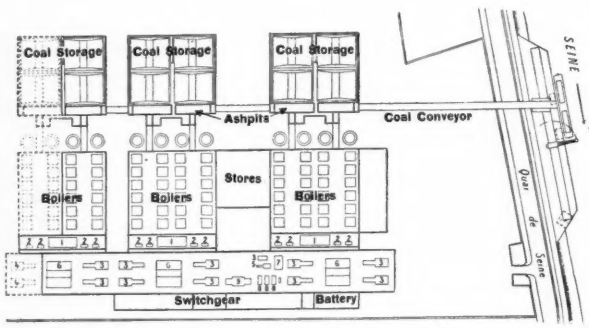


Fig. 10.—Showing Arrangement of Electrically-driven Air Pumps.

together by a magnetic clutch; either direct current at 500 volts or two-phase current at 6,000 volts can be obtained, the speed of the set being 500 R.P.M. and the capacity 1,675 K.V.A.



1. Boiler feed plant.
2. Water meters.
3. 6,000-KW. turbine units.
4. Projected 6,000-KW. units.
5. 300-KW. turbine unit.
6 and 7. Open condenser basements.
8. Motor-generators.
9. 2-ph.—3-ph.—D.C. motor-generator.

FIG. 11.—BLOCK PLAN OF THE ST. DENIS POWER STATION.

The excitation for the two-phase generators is taken from the 225-volt station bus-bars; this generator is a ten-pole machine, with an output of 1,850 K.V.A., with the working power factor ·8, and the direct current generators are each eight-pole machines, with, however, eight smaller auxiliary poles for commutation purposes.

The latter machines have each an output of 1,400 amperes, their respective capacities being 750 KW.

This set was supplied by the Societé Parisienne Electrique, of Jeumont.

A most complete switchgear has been installed for handling the different circuits supplied, in a special building.

The latter has four floors and a basement, the three lower floors are sub-divided by a longitudinal masonry division containing shelves whereon are mounted the bus-bars supported by porcelain insulators. Masonry chambers facing the bus-bars contain the generator and feeder oil switches. The upper switch floor is open to the engine room, as shown in fig. 7; it contains a remote control apparatus.

Facing the engine room are the generator control panels and along the rear wall, similar panels for operating the feeders, both being of the inclined bench type, with the instruments mounted vertically behind. The large oil switches are electrically operated by motors; automatic electric rewinding Aron meters are used in each 10,250-volt feeder circuit, and special metering apparatus on the miscellaneous circuits. A special switch panel is provided for operating two or more alternator groups in parallel, which contains a large wheel for simultaneously regulating the rheostats of the machines, also three 3,000-ampere sector-pattern ammeters, and a circuit breaking device, intended to break the fields of the machines in case of short circuits.

The auxiliary switchgear for controlling the converters, &c., is installed in the engine room under the stairway leading to the H.T. control floor, being mounted on 10 panels in grey marble.

An instrument column is also provided adjacent to each turbo-generator, containing a large dial with voltmeter, ammeter and kilowatt scales, visible on both sides; also lower down, an Aron meter and a control switch for cutting off current.

The switchgear was supplied by Messrs. Brown, Boveri and Co., who, it will be gathered, carried out a great portion of this important installation, and to whom, in conjunction with Messrs. Babcock & Wilcox—the contractors for the steam raising and coal conveying installation—we are indebted for many of the views here given. For figs. 1, 2 and 11 we are indebted to *La Revue Electrique*.

In concluding, we may refer our readers to the important developments in electricity supply pending in Paris, which have frequently been referred to in our columns, and in connection with which the completed St. Denis station may be expected to play an important part.

Great progress is being made industrially in the neighbourhood of Paris, and this, in conjunction with the anticipated demand of the Parisian Secteurs, will call for a considerable output of energy, estimated at 70,000 KW.-hours per day, to the Metropolitan Railway and Edison Secteur, at the commencement of operations.

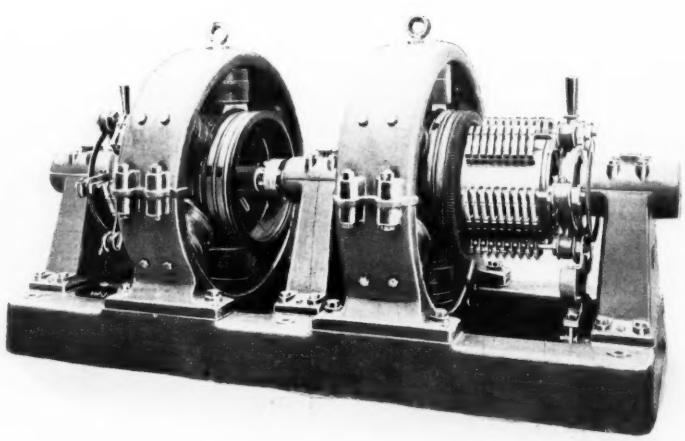


FIG. 12.—BROWN, BOVERI 110-H.P. BOOSTER SET.

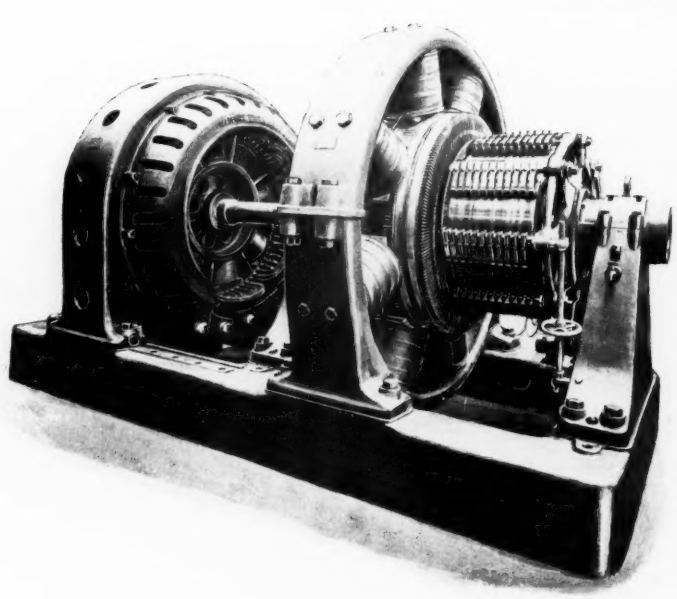


FIG. 13.—BROWN, BOVERI 375-KW. MOTOR-GENERATOR.

TELEGRAPH and TELEPHONE NOTES.

(*Concluded from page* 61.)

Austria.—The *Nachrichten über Industrie, Handel, und Verkehr aus dem Handels-ministerium* for December gives some interesting particulars concerning the Austrian telegraphs in 1905. From the published statistics it appears that the mileage of telegraph lines increased from 41,383 km. in 1904 to 41,867 km. in 1905. The number of telegraph instruments in use was 6,136, and 18,200,000 telegrams were dealt with; 335 telephone exchanges (as against 317 in 1904) with 53,000 subscribers, gave a total of 164,200,000 conversations, as against 155,100,000 in the preceding year. The staff increased from 56,557 in 1904 to 57,028 in 1905. The total income for 1905 was 125,200,000 crowns, as against 123,900,000 in the preceding year, and the expenditure was 126,400,000 in 1905 as against 121,700,000 in 1904.

Chile.—It is stated that Mr. A. E. Price, of Valparaiso, has obtained a concession for the establishment of telegraph lines between Santiago and Iquique, with various intermediate stations and branch lines.

Edinburgh.—An underground telegraph cable is to be laid connecting Edinburgh with Glasgow, thus making underground connection between London and the Scottish capital; the construction of the new cable was commenced this week, and the contract for laying the pipes has been placed with Mr. Andrew Blair, of Glasgow.

Natal.—The extent of the telegraph and telephone systems in Natal at December 31st, 1905, was 2,914 and 216 km. of telegraph and telephone lines with 9,903 and 3,711 km. of wire respectively. There were also 50 km. of private lines with 279 km. of wire. The number of telegrams handled was 2,170,833 of which 587,253 were sent, 654,406 received and 929,174 were telegrams in transit. Receipts from the telegraph service were 1,345,162 fr. (about £53,806), and from the telephone service 151,932 fr. (about £6,077). —*Journal Télégraphique.*

New Cable.—Reuter reports that the British c.s. *Duplex* arrived at Palma de Majorca on Thursday last week to lay a direct cable between Majorca and Barcelona.

Rhodesia.—For the year ending March 31st, 1905, the telegraphs and telephones in Southern Rhodesia comprised 4,464 km. of line and 9,498 of wire, whereas the figures for the year ended March 31st, 1906, were 4,497 and 9,531 km. respectively. Progress for the last year is thus represented by 33 km. of line and of wire.

During 1904-5 there were 526,535 telegrams, of which 177,124 were sent, 191,758 received and 157,653 in transit. The figures for telegrams sent only are given for the year 1905-6, and they are 198,132. The sum received for ordinary and Press telegrams was divided among the Administrations taking part in transmission, as follows:—Southern Rhodesia, for 1904-5, 286,214 fr. (about £11,448), and for 1905-6, 327,777 fr. (about £13,111); South and East Africa, for 1904-5, 42,886 fr. (about £1,715), and for 1905-6, 47,469 fr. (about £1,899). The proportion accruing to the interested cable companies was, for 1904-5, 195,839 fr. (about £7,833), and for 1905-6, 201,104 fr. (about £8,044).

At the end of March, 1905, there were 83 telegraph offices in Southern Rhodesia, of which 16 were in Bechuanaland. At the end of March, 1906, there were 90 offices.

For the same periods, the numbers of employés were 216 and 204 respectively, 96 thereof being white.

The number of telephone subscribers decreased from 283 at March 31st, 1904, to 269 at March, 1905. Salisbury claimed 91, Bulawayo 117, Umtali 29, Selukwe 18, and Gwelo 14. The revenue derived for the two periods amounted to 89,575 fr. in 1904-5 (about £3,583), as compared with 99,075 fr. in 1905-6 (about £3,963). The decrease in the number of subscribers is ascribed to the commercial crisis in the Colony.

Receipts for 1904-5 were 648,150 fr. (about £25,922), and for 1905-6, 689,050 fr. (about £27,562). Expenses for the same periods were 547,375 fr. (about £21,895) and 519,875 fr. (about £20,795) respectively, leaving a surplus of about £4,032 for 1904-5 and of about £6,767 for 1905-6.—*Journal Télégraphique.*

Russia.—The *Board of Trade Journal* learns that the Russian Government intends as soon as possible to improve the telegraph service of that country by constructing lines to link up the small outlying towns with the chief towns in each district. From this it will be seen that telegraphic communication in Russia is still in a very backward state.

Swansea Telephones.—The Postmaster-General has offered the Corporation £22,000 for the municipal telephone system. The capital expended on the undertaking up to March last was £27,172; but the buildings, which cost £2,450, will remain the property of the Corporation.

Telephone Delays.—The Leeds Chamber of Commerce recently held a discussion as to the trunk telephone delays between Leeds and Birmingham and Liverpool, which, it was stated, caused the greatest inconvenience to business men. It appeared that a trunk call between Leeds and Birmingham meant a delay of from 50 minutes to 4 hours; the delay over a trunk call between Leeds and Liverpool and district amounted to from 1½ hours to 2 hours on several occasions.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	..
Paramaribo-Cayenne	Nov. 27, 1906	..
Cayenne-Pinheiro	Aug. 13, 1902	..
St. Lucia-Martinique	May 7, 1902	..
Dominica-Martinique	May 7, 1902	..
Guadeloupe-Martinique	Aug. 29, 1906	..
Mole St. Nicholas-Port au Prince	Aug. 16, 1906	..
Curacao-Coro / Curacao-La Guayra / Curacao-Maracaibo } Closed	Jan. 12, 1906	..
Reissa-Issa and Reissa-Yemani (Yemen)	Oct. 22, 1902	..
Tarifa-Tangier	Jan. 18, 1904	..
Port Arthur-Chifu (Closed)	Mar. 9, 1904	..
Garachico-Santa Cruz	July 12, 1906	..
Las Palmas-Arecife	Aug. 18, 1906	..
Guantanamo-Mole St. Nicholas	Nov. 22, 1906	..
Mole St. Nicholas-Cap Haytien	Nov. 22, 1906	..
Fao-Bushire	Dec. 4, 1906	..
Martinique-Paramaribo	Dec. 17, 1906	..
Gibraltar-Tangier	Jan. 2, 1907	..
Landlines.		
Puerto-Barrios	Aug. 28, 1902	..

Transvaal.—At June 30th, 1905, the telegraph and telephone systems of the Transvaal consisted of 3,939 kilometres of line and 15,245 kilometres of wire, and there were 104 telegraph offices, this number being an increase of five over the preceding year. Besides these there were also 113 public telegraph stations belonging to railway companies.

The number of all telegrams sent and received during the period under review was 3,435,986, as against 3,550,257 during 1903-4. Included in this number are 1,258,869 telegrams to the interior, as well as 58,567 cable telegrams; 845,314 telegrams in transit, and 1,273,236 telegrams from the interior and from foreign countries. The number of cable telegrams for the Transvaal was 64,894. Traffic with Johannesburg increased by 114,529 telegrams, whereas for the rest of the Transvaal there was a diminution of 223,159 telegrams.

The revenue for the year was 2,709,374 fr. (about £108,375), as against 2,609,819 fr. in 1903-4 (about £104,393), an increase of about £3,982. Direct telegraphic communication was established between the Exchange at Johannesburg and those of the towns of Kimberley, Cape Town, Port Elizabeth, Durban, Pietermaritzburg and Pretoria.

The Government also reduced the inland rate from 1s. for ten words and 6d. for every additional five words, to 1d. per word, with a minimum charge of 1s. This alteration makes all the rates in South Africa uniform.

In the district of Johannesburg there were 514 kilometres of telephone line and 12,330 of wire, whereas the district of Pretoria owned 150 kilometres of line and 2,174 of wire. At Johannesburg there were 1,314 ordinary and 73 Government stations; at Pretoria, 282 and 83; at Germiston, 52 and 8; at Krugersdorp, 30 and 6; and at Boksburg, 33 and 7, making in all 1,888 offices.

Telephone receipts amounted to 1,145,912 fr. (about £45,836), as against 844,203 fr. (about £33,768) in 1903-4. The cost of maintenance was 70,406 fr. (about £2,816).—*Journal Télégraphique.*

Wireless Telegraphy.—The German cruisers *Vineta* and *Munchen*, which are equipped with wireless telegraph apparatus for experimental purposes, are being overhauled at the Imperial dockyards at Kiel and Wilhelmshaven, and will leave the yards during the present month. A sum of £37,000 is proposed for improvements in the warship wireless stations in the financial year 1907-8. It is stated that the *Munchen* has already established communication between Bergen and the Norddeich station, that is to say, a distance of over 740 miles, and it is proposed this year to endeavour to extend the connection as far as Tromso. Very favourable results have also attended the trials in the German merchant marine. The Lloyd steamer *Bremen*, for instance, is reported to have maintained communication with the station at Nauen, near Berlin, for a distance of 1,488 miles, and the Hamburg steamer *Kap Ortegal*, a distance of 1,520 miles.

Reuter reports that experiments in wireless telegraphy have been carried out on the French island of Porquerolles. There is an important station on the island which has succeeded in communicating to a distance of over 1,200 miles. Telegrams were received from Poldhu, in Cornwall, very clear results being obtained.

In connection with the Amir's visit, the Indian Government telegraph officials have established communication between Landi-Kotal and Peshawar by means of wireless telegraphy. Great importance is attached to this installation amid the lofty hills of the Khyber Pass, says the *Standard*, owing to the difficulty of maintaining intact the ordinary land wires, which are liable to be cut by unfriendly hill tribes. The heliograph cannot be worked between these outlying military stations continuously, because of the frequent mists which envelop the passes.

CONTRACTS OPEN and CLOSED.

OPEN.

Australasia.—January 14th. According to *Australasian Hardware and Machinery*, tenders are being invited for telephones (9,000), magneto wall sets, for the Postmaster-General's Department,

Commonwealth of Australia. Specifications, &c., at the Offices of the Deputy Postmaster-General, Sydney, Melbourne, Brisbane, Adelaide, Perth and Hobart. Tenderers to state name of country in which telephones will be made. Deposit, 5 per cent. on the amount up to £1,000, and 2½ per cent. on any further amount in excess of £1,000. Tenders to Deputy Postmaster-General, Melbourne.

Bermondsey.—February 6th. Carbons, conduits, meters, cables, &c., for the electricity and destructor department of the Council for one year. See "Official Notices" to-day.

Bridlington.—January 19th. Pumping machinery for the Corporation waterworks. See "Official Notices" November 30th.

Derby.—January 19th. Water-tube boiler, &c.; economisers; induced draught plant; coal bunkers, conveyors, &c., for the electricity department. See "Official Notices" January 4th.

Dublin.—January 29th. The Dublin Port and Docks Board requires tenders for electrical pumping machinery and electric wharf cranes. Particulars from Mr. John P. Griffith, engineer to the Board, East Wall, Dublin, on payment of £1.

Glasgow.—January 14th. Electric wiring and fittings for the Police Department new buildings. Office of Public Works, 64, Cochrane Street.

Hackney.—January 24th. Arc lamp carbons for the electricity department for one year. See "Official Notices" to-day.

Iceland.—March 31st. The Reykjavik Town Council is open to give a concession for the supply of electrical energy and gas. See "Official Notices" December 7th.

Ilford.—January 22nd. Economiser for the U.D.C. electricity works. See "Official Notices" to-day.

Islington.—January 24th. Tenders to the B.C. for an electrically-driven capstan. See "Official Notices" January 4th.

Launceston (Tasmania).—January 21st. Three-phase motors for one year. See "Official Notices" December 7th.

London.—January 23rd. The Metropolitan Asylums Board is inviting tenders for telephone and bell installations at the North-Eastern Fever Hospital. See "Official Notices" Jan. 4th.

L.C.C.—January 22nd. Thirteen induction motor-generators of 500 KW., and four of 150 KW. capacity. See "Official Notices" December 21st.

L.C.C.—January 22nd. 200 or 300 double-deck roof-covered car-bodies; 300 pairs of maximum traction swing bolster trucks; 300 electrical equipments for operation upon the overhead trolley and conduit system. See "Official Notices" December 28th.

Llandudno.—January 14th. Traction switchboard and surface condensing plant for the U.D.C. See "Official Notices" January 4th.

Pozega.—January 21st. The municipality of Pozega, Austria, invites tenders up to January 21st for the erection of an hydro-electric installation, supply and erection of equipment, &c. Articles 1 to 3 relate to the construction works. Article 4, supply and erection of two 90 to 100 H.P. Francis turbines, with transmissions, &c., complete (estimated cost 30,000 kr.). Article 5, supply and erection of a 120-H.P. Diesel motor (estimated cost 40,000 kr.). Article 6, supply of material and erection of the lighting network, including 20 8-ampere arc lamps, 100 32-C.P. glow lamps, 30 16-C.P. reserve lamps, and 50 lamps in the Town Hall and school; also 20 U-shaped iron standards for the arc lamps (estimated cost 63,000 kr.). Also alternative proposals for a steam, Diesel, or suction gas generating set, with estimates of first and working costs. Particulars of the Burgermeisters-amt.

Spain.—January 15th. The municipal authorities of Balaguer (province of Lerida) are inviting tenders until the 15th inst. for the concession for the public and private electric lighting of the town during a period of 11 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Balaguer (Lerida).

Warrington.—January 28th. Cables, switchboard panel and transformers, for the Electricity Department. See "Official Notices" to-day.

CLOSED.

Accrington.—The Electricity Committee has decided to accept the Brush Electrical Engineering Co.'s tender for the new tramcars and overhead equipment, at £19,450, subject to the payment of the standard rate of wages in the district.

Bury (Lancs.).—The T.C. has accepted the following tenders:—

Walter Scott, Ltd., Leeds.—Rails and fishplates.
Ibbotson Bros., Ltd.—Tie bars, fish bolts and nuts.
Forest City Electrical Co.—Copper rail bonds.
Thermit, Ltd.—Alumino thermic welding material.
W. T. Glover & Co., Ltd.—Cables.
Mr. W. H. Keys, West Bromwich.—Bitumen and asphalt.
Howard Troughing, Ltd.—Asphalt troughing.

Birkenhead.—The Tramways Committee recently decided to accept a tender by Messrs. Mountain & Gibson, of Bury, for the supply of 14 pairs of maximum traction trucks for cars on the Woodside—New Ferry route. At the last meeting of the T.C. the acceptance of the tender in question gave rise to some discussion. Alderman Gamlin drew the attention of the Council to the fact of there being a firm that carried on considerable business in the building of tramcars in Birkenhead—Messrs. Milnes & Voss—who had made cars for all parts of the world. He understood that tenders had not been invited from this particular firm. Councillor W. G. Wall explained the action of the Committee as being due to the fact that the Bury firm was able to deliver the trucks in a very short time. He further assured the Council that the trucks would all be of English make.

Cleckheaton.—The U.D.C. has accepted the tender of the Phœnix Dynamo Co. for the supply of a generator and switchboard.

East London.—The T.C. on December 13th accepted the tender of the General Fire Appliances Co., Ltd. (£1,735), for the installation of Gamewell street fire alarms. The necessary wiring and erection of outside circuits are to be carried out departmentally, at an additional cost of £388.

Guildford.—The T.C. has accepted the tender of Messrs. Manlove, Alliott & Co. for a four-cell refuse destructor, at £4,240.

Halifax.—The T.C. has accepted the tender of the British Insulated & Helsby Cables, Ltd., for the supply of 776 yards of pilot cable, at £112 18s.

Hammersmith.—In accordance with a resolution passed by the B.C. in May last, the engineer has made careful tests of the sample carbons submitted by various contractors earlier in the year. The result of the tests, it was reported on Monday, has been in favour of the carbons supplied by Messrs. Geipel & Lange and the General Electric Co., Ltd. Quotations were invited from these two firms for the supply of carbons estimated to cover the Council's requirements during the two years ending December 31st, 1908. The prices received were as follows:—

Geipel & Lange	(accepted)	£288 11
General Electric Co.		433 18

Letchworth.—The directors of the First Garden City Co., Ltd., have accepted the tender of Messrs. Johnson & Phillips, Ltd., for supply and erection of electrical plant for lighting and power at Letchworth. The contract includes gas plant, engines, dynamos switchboard, battery, and overhead mains.

The order for the battery of 260 L.L. 13-plate cells for Letchworth has been placed with the D.P. Battery Co., Ltd., of Bakewell.

London.—The Great Western and Metropolitan Railway Cos. have accepted the tender of Messrs. Johnson & Phillips, Ltd., for lighting the new train sheds at Hammersmith, including the supply of arc lamps, cables, contact gear and winches.

Roumania.—The Roumanian State Railway authorities in Bucharest have just placed a contract with Messrs. Felten and Guilleaume, of Mulheim-am-Rhein, for a large quantity of insulated electric cable.

Swansea.—The E.L. and Tramways Committee of the T.C. has accepted the tender of the Mannesmann Tube Co. for the supply of steam pipes for generating sets.

Tunbridge Wells.—The T.C. has accepted the tender of W. T. Henley's Telegraph Works Co., Ltd., for the supply of cables for the ensuing year.

Wallasey.—The Council has accepted the tender of Messrs. Dick, Kerr & Co., Ltd., for the supply of five tramcars, at £666 each.

War Office.—Messrs. Newtons, Ltd., of Taunton, have lately received from the War Office a repeat order for electric motors of their Zone patent type. These machines are required for the Royal Gunpowder Factory and the Royal Small Arms Factory.

FORTHCOMING EVENTS.

To-day's Events (Friday, January 11th).—At 7.30 p.m. Institution of Electrical Engineers (Manchester Students). Mr. F. Shaw on "Electric Lamps."

Armstrong College Engineering Society. Mr. E. W. Hood on "Gas Engines."

Saturday, January 12th.—Association of Engineers-in-Charge. Social Dance.

At 7.30 p.m. Birmingham and District Electric Club. Presidential address by Mr. W. H. Whitehouse.

Monday, January 14th.—At 8 p.m. Institution of Electrical Engineers (Newcastle). Mr. E. P. Hollis on "Points in Power Station Design and Operation."

Institution of Mechanical Engineers (Graduates). Mr. A. B. E. Cheeseman on "Portland Cement and the Machinery Used in its Manufacture."

Tuesday, January 15th.—At 8 p.m. Faraday Society. Mr. E. E. Fournier D'Albe on "The Application of the Electron Theory to Electrolysis."

At 8 p.m. Institution of Civil Engineers. Mr. Francis Fox on "The Simplon Tunnel." (Further discussion.)

Wednesday, January 16th.—At 7.30 p.m. Institution of Electrical Engineers (Birmingham). Discussion on "Recent Improvements in Electric Lighting." Introduced by Mr. A. H. Bate.

At 7.30 p.m. Institution of Electrical Engineers (London Students). Discussion on Prof. J. Epstein's paper "Selection and Testing of Materials for Construction of Electrical Machinery."

At 8 p.m. Society of Arts. Adjourned discussion on Mr. J. W. Gordon's paper "Patent Law Reform."

At 2.45 p.m. (Paddington). Institution of Civil Engineers (Students). Visit to the G.W.R. Park Royal generating station.

Thursday, January 17th.—At 8.30 p.m. Chemical Society. Meeting.

Friday, January 18th.—At 8 p.m. Institution of Mechanical Engineers. Adjourned Discussion on "Lighting of Railway Premises: Indoor and Outdoor," by Mr. H. Fowler. Prof. H. C. H. Carpenter and Mr. C. A. Edwards "On the Properties of the Alloys of Aluminium and Copper." (Eighth Report to the Alloys Research Committee.)

At 9 a.m. Royal Institution. Sir Andrew Noble, Bart., on "Fifty Years of Explosives."

Saturday, January 19th.—At 10 a.m. Institution of Electrical Engineers (London Students). Visit to the Silvertown Works of the I.R., G.P. and Telegraph Works Co., Ltd.

Institution of Electrical Engineers (Manchester Students). Visit to Messrs. Dick, Kerr & Co.'s Works at Preston.

NOTES.

Picketing and Intimidation.—The Labour Protection Association, 25, Victoria Street, London, S.W., whose object, we are informed, is to watch all trade disputes and defend the interests and rights of masters and free workmen during strikes, has issued the following circular to its members, and to Employers' Associations throughout the country, under the title:—"The Trade Disputes Act and the Protection of Free Labour against Picketing and Intimidation":—"Parliament having relieved labour unions of all responsibility for the acts of their agents during trade disputes and strikes, and conferred upon these organisations the right to picket in unlimited numbers (for the purpose of 'persuading' a person to do that which he is unwilling to do) any place where such person (workman or master) may work, reside, or happen to be, the necessity has arisen for such steps to be taken as will protect free workmen and their masters against intimidation, molestation, annoyance, or the other evil features of labour-union warfare. The Labour Protection Association is prepared, at short notice, to provide its members with an adequate number of experienced men, who have served in the military, naval, or police forces, to undertake the watching and counter-picketing of factories, workshops, mines, railways, and of all places where work or business is carried on which may be picketed by the agents and emissaries of the labour unions. The Association would thus safeguard the property and person of all who may be in fear of the ruffianism, brutality, and terrorism (humorously and now by statute called 'peaceful persuasion') which so often characterise the methods of labour unionism in enforcing its demands and furthering its ends."

The Government and the Electrical Industry.—The *Manchester Evening News* for 7th inst. contains the following interesting statement:—"We learn, however, that during the coming session of Parliament an effort will be made to remove some of the bars to electrical progress by the proposal of a Standing Committee appointed in affiliation with the Institution of Electrical Engineers, strengthened by representative experts from Chambers of Commerce and other interests concerned, with which Government and State departments can confer when framing or amending statutes or regulations."

Single-phase Traction.—Such is the progress of single-phase current working, says the *Elektrotechnik und Maschinenbau*, that this system is now extended to 31 railways (including those under construction and projected), having a service mileage of nearly 1,000 km. Of this total, 750 km. fall to the United States. About 50 per cent. of the aggregate in working are equipped with Westinghouse motors of a total capacity of 70,000 H.P. (35,000 H.P. of which is used on the New York, New Haven and Hartford Railway). Sub-divided according to trolley-wire pressure, these lines group themselves as follows: Four with 2,000 to 2,500 volts; eight with 3,000 to 3,300 volts; eight with 5,000 to 6,600 volts; and two with 10,000 to 15,000 volts, while there are seven worked by both D.C. and A.C.

Fatalities.—According to the *Sydney Daily Telegraph*, in November last a telephone lineman was at work on a pole with a pot of hot paraffin wax, when, by some means, the latter caught fire, and the flames enveloped him. He was helped to the ground, and the flames were extinguished, but the shock led to his death.

Last month a workman named W. Lawry was killed at Messrs. Siemens Bros. & Co.'s Dynamo Works, Stafford, by the fall of a heavy bracket, which was being moved by means of an electric crane. The inquest showed that the disaster was purely accidental.

At the works of the Perfecta Seamless Steel Tube and Conduit Company, Limited, at Aston last week, William Spencer, aged 20, whilst following his occupation, was placing the band on a pulley, when his coat sleeve became entangled and he was dragged round the shafting. Before the machinery could be stopped his left arm was torn off, the other arm was broken and his legs were shockingly mutilated. He died soon after admission to the hospital.

A young electrican named Reeves employed by the Bloemfontein municipality, was killed one afternoon early in December while at work in the western suburb, which is being connected up with the electric light station. He was at the top of a high pole fixing wires, when the pole snapped at the base throwing him to the ground and killing him instantaneously.

We regret to learn that on Tuesday, while a water-brake was under test at the works of Messrs. Willans & Robinson, Ltd., at Rugby, it burst, killing the foreman of the testing department (Mr. C. Kinden) and an assistant engineer (Mr. S. Bradwell), also seriously injuring two workmen.

The *Birmingham Daily Post* says that the death has occurred of Herbert Griffiths, electrician, of Chester, as the result of injuries recently sustained at the Park Hall Colliery, Longton, on the 12th ult. It is said that the deceased was engaged installing an electric motor for haulage purposes, and while so employed in the electricity house, which is underground, the switchboard was suddenly enveloped in flames from some cause which will form the subject of inquiry at the inquest. Griffiths and an assistant named Stephen Smith were standing at the switchboard, and both were severely burned. The deceased was subjected to intense heat in the face and on the hands, with the result that the face was badly disfigured and the hands charred. The sight of one eye was destroyed, and it was doubtful whether the sight of the other eye could have been saved if he had lived. Smith, the assistant, is progressing satisfactorily.

Acetylene Lighting.—On December 31st, a man named James Russell was killed by an explosion of acetylene gas, which occurred while he, together with two others, was removing an acetylene gas tank from its couplings in a shed at Navan. They had a lantern to give them light. Russell was hurled some distance, and died in half-an-hour. At the inquest, a letter was read from Captain J. H. Thomson, Chief Inspector of Explosives on the dangers attending the use of acetylene, in which he said:—"I gather from what you say that it was caused by the ignition of a gaseous mixture of acetylene and air remaining in the gasholder and ignited by a naked lamp. This being the case, it is not necessary for us to inquire further into the accident, as unfortunately similar occurrences have not been infrequent. I think it might be desirable if, at the inquest and elsewhere, you would give the fullest possible prominence to a warning as to the danger of attempting any repair to acetylene apparatus without first removing all trace of acetylene by thorough ventilation of the parts, and that even when this has been done it is desirable to avoid, if possible, the use of naked lights in carrying out the repair." It is interesting to place beside such a statement as this, the claim put forward by acetylene gas apparatus suppliers in enticing consumers, that their plants are absolutely safe.

We learn that a slight frost recently caused considerable inconvenience at Kildare Railway Station. The Great Southern and Western Railway Co. have their own acetylene plant, but they were entirely without light the week before last, owing to the generator being frozen up.

London Telegraph Training College.—In connection with the recent note on our visit to this college, we omitted to make it clear that although the college was removed to Earl's Court last year, it is the same institution which we visited and described in 1904, at Saltoun Road, Brixton. This was purchased from the previous proprietor by Mr. H. W. R. Child, who has reorganised it and removed it to the new premises.

Electro-Chemical Notes.—THE ELECTRICAL DISCHARGE IN AIR AND ITS COMMERCIAL APPLICATION.—In the tenth number of the *Electro-Chemical and Metallurgical Industry*, Vol. IV, a series of interesting experiments on discharges in air is recorded, of which the following abstract gives a brief summary. One of the authors—W. Cramp and S. Leetham—discovered in 1903 that ozonised air, after being passed between points discharging electric sparks, possessed the property of being able to bleach flour in a very marked manner. This behaviour is due to the joint action of the ozone already present and the oxides of nitrogen produced by the spark discharge. The apparatus at present employed for the production of large quantities of this active air for industrial purposes consists essentially of a sheet iron case in which are fixed an alternator, a transformer, a switchboard, an ozoniser and a sparking device. In addition, a small Roots blower is attached, and a filter to clean the air. The normal quantity treated is approximately 100 cb. ft. per minute, and this contains, after passing the delivery flange, air, ozone, and oxides of nitrogen in the proportion 40,000 : 3 : 1 by volume.

Hitherto all types of alternating electrical discharges have been divided into three classes:—(1) The ordinary arc; (2) high-tension discharge between spark points; (3) the silent discharge. These have been considered as separate and distinct phenomena depending on the effects produced by each. But if a pair of insulated points is given an increasing potential difference the following series of events takes place:—(*a*) The air is put into a state of stress. (*b*) Small conducting paths appear, giving rise to blue streamers issuing from the points. (*c*) These latter thicken and join up the points. (*d*) The thicker streamers become a discharge. There is, however, no discontinuity, although this arrangement includes both sparking and silent discharge. The character of the product of the discharge depends upon the voltage at the terminals for a given current. Thus, in plotting curves of current against voltage, to the right of a certain point a hot arc is produced, and oxides of nitrogen are formed. On the other side a silent discharge is set up, and the air is ozonised. The change from one side to the other, is, however, quite continuous and gradual. In fact, it may be concluded that all types of electrical discharge in air behave similarly, and may be steadied by similar means. The facts detailed in the paper are best explained on the supposition that ions are produced under an electric strain. As the E.M.F. increases, the amount of ionisation increases, and the intervening gap is better able to conduct the current. An air current will, however, remove these ions and delay the first spark discharge. This also explains why a lower E.M.F. is required to maintain an arc than that required to start one.

It has hitherto been usual to speak of the silent discharge as though it were a perfectly well-known effect, producing a chemical result, well defined. If, however, an Andreoli ozoniser be connected to alternating-current mains, with gradually increasing pressure it is found that a violet glow is set up between grids and mica which produces an excellent yield of ozone. Later this becomes yellow, and the percentage of ozone decreases, but oxides of nitrogen make their appearance, and increase with the E.M.F. continually. The formation of the latter substances can also be best explained on the assumption of gaseous ionisation. To obtain a good yield of the oxides of nitrogen, it is not necessary to employ a high temperature, but rather to expose a large volume of air to the ionising effect of the discharge. For the production of ozone, the discharge should take place between points, and be controlled by a high steadying resistance to prevent the formation of a flame. A high frequency may be used with advantage, but clean, dry and cool air must be supplied.

Smoke Prevention.—A lecture on "Smoke and its Prevention" will be given on January 17th at the Royal School of Military Engineering at Chatham by Mr. W. H. Booth, official lecturer to the Smoke Abatement Society of London.

Midland Railway.—We announced a short time ago that Messrs. Siemens Bros. & Co. had obtained a contract for the equipment of two motor-cars for running over the company's Morecambe and Heysham lines, which it has been decided to electrify on the single-phase system. It is now reported that the British Westinghouse Co. has been given a contract for a third equipment, and that it is intended to work all three cars as one multiple-unit train, the same control gear operating the equipments of both firms. It is also stated that probably the electric service will be open for public traffic about June or July next.

Appointments Vacant.—Electrical meter inspector for the Natal Government Railways, Durban (£210); mechanics for the electrical engineers' department at Devonport Dockyard (34s.), also three sub-station attendants (35s.); a chief electrical engineer is required by the Tonbridge U.D.C. at £150 per annum; electrical and mechanical engineer for Swindon (£200). See "Official Notices" to-day.

Institution Notes.—Armstrong College Engineering Society.—We learn that this Society is making good progress, and that during the present session visits have been arranged to several prominent works in the district. Visits have already been paid to the N.E. Railway Co.'s locomotive works and Messrs. C. A. Parsons and Co.'s works. A number of interesting papers are to be read during the next three months, announcements of which will be duly made in "Forthcoming Events."

Royal Institution.—The final lecture of Mr. W. Duddell's series on "Signalling to a Distance" was delivered on Tuesday last. These lectures appear to have been highly interesting and successful, and have attracted much attention.

Last month two lectures on "Electricity" were delivered in the Royal Dublin Society's Theatre, Dublin, by Mr. J. Rogerson Cotter, M.A.

Northampton Institute.—On Friday, the 25th inst., Mr. Evan Spicer, the chairman of the L.C.C., will distribute the prizes and certificates at the Annual Conversazione.

Poor Beggars.—A manufacturing correspondent has sent us copies of applications received asking for subscriptions for a firm's annual Christmas-box fund, or for the annual supper of the employés of a certain municipal Corporation. As we have repeatedly stated, we regard it as a most reprehensible practice that electrical manufacturers should be subjected to this sort of thing. We all know what the feeling is—"Well, if I don't subscribe, I may lose the chance of doing business, and so-and-so, who does subscribe, as the printed list sent shows, will have a decided advantage over me." There is too much of this open sponging on other people for the cost of an annual festivity, and we hope electrical departments will set their faces against it.

The Greenwich Boiler Explosion.—The adjourned inquiry respecting the deaths of W. W. Shaw and J. P. Coombes, who were killed by a boiler explosion at the South Metropolitan Electric Light and Power Co.'s works at Blackwall Point, Greenwich, was concluded on Tuesday last. Further evidence as to the construction of the thermal storage drum which exploded was given by Mr. Richard A. McLaren, manager of the Renfrew Works of Messrs. Babcock & Wilcox. He mentioned that the drums were made of the best mild steel, supplied by a Glasgow firm; the steel was tested to 24-28 tons per sq. in., and a 10-in. test strip to an elongation test of 25 per cent. During 1906 his firm turned out some 4,000 drum ends similar to the fractured one, and less than ·5 per cent. failed to pass the tests. Mr. Ed. G. Hillier, chief engineer, National Boiler Insurance Co., said he had come to the conclusion that some part of the drum was missing before the explosion occurred, probably in the neighbourhood of the leak which had been noticed. He believed a defect existed in the original plate, due to its treatment in manufacture. The leak in question was in the plate, and not at a joint. The jury returned a verdict of "Accidental death."

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Engineers.—The question of the appointment of a successor to Mr. Taite, the late electrical engineer, is giving some trouble to the Salford Borough Council. Mr. Taite had asked to be relieved of his duties on December 31st. The Electricity Committee recommended that the request should be acceded to, on condition that Mr. Taite undertook to attend their meetings when his report on the projected extensions is under consideration, and also to supervise the installation and the testing of the turbo-generator. For these services they proposed to pay him 100 guineas. The Committee also approved of an advertisement for an electrical engineer, at a salary of £800 per annum, rising by annual instalments to £1,000. At last week's meeting of the Council several members objected to the arrangement with Mr. Taite, on the ground that the appointment of a competent man should render it unnecessary. Mr. Hodgson, chairman of the Committee, said the Committee had under consideration plans for an extension of plant, which might involve an expenditure of £200,000. Mr. Taite being familiar with the plans, the Committee thought it would be advisable to retain his services, in a consultative capacity, until they were prepared with a scheme to lay before the Council. The Committee's recommendation was approved by 24 votes to 4. Exception was taken to the proposal regarding the salary to be paid to the new engineer, and the Council, after disposing of several amendments, finally adopted the Committee's recommendations. The salary will begin at £800, and will rise to £1,000 by annual increments of £50, but each increase is to be at the Committee's discretion.

On Thursday, 3rd inst., Mr. C. Wyatt, assistant in the Croydon mains department, was made the recipient of a set of technical works on the occasion of his leaving to take up an appointment with Messrs. Penrose & Co. The staff of the mains department afterwards held a smoking concert.

The Warrington Electricity Committee has recommended that the salary of the electrical engineer (Mr. Mathias) be increased from £300 to £350 per annum, and that he be allowed to take not more than two pupils at any one time.

The Darlington T.C. has appointed Mr. C. F. Gregory, of Glasgow, as junior engineer-in-charge of the electricity works.

Mr. A. W. Dumbrill, whose six months' engagement on trial as commercial assistant to the Battersea electrical undertaking expires on the 30th inst., is to be re-engaged to continue canvassing at a wage of £2 per week and commission.

According to a Westmorland paper, the Kendal Electricity Committee recently resolved that in view of the separation of the Electricity Committee from the Gas and Water Committee, it was advisable to appoint an independent manager of the electricity undertaking; that Mr. Barnes be appointed manager at a salary of £125 per annum; that Mr. Thomson be requested to retire from the management of the electricity department on December 31st, and that the sum of £6 5s. be paid to him in addition to his salary to that date.

Mr. V. J. Allan, shift engineer at the Rochdale Corporation electricity works, has been appointed to a similar position with the Kent Electric Power Co. He was presented by the staff with a travelling bag on the occasion of his leaving Rochdale.

Mr. J. A. B. Howley, electrical engineer to Tonbridge U.D.C., has resigned, he having accepted a position with the Harrow E.L. and Power Co., Ltd.

Mr. T. Medcalf, traffic manager of the Swindon Corporation Tramways, has now been appointed tramways manager and general commercial manager of the Electric Lighting Department. We understand that the Council, in making the appointment, are looking to Mr. Medcalf to develop and put both undertakings on a sound financial basis.

Tramway Officials.—The staff of the Birkenhead Corporation Tramways have presented a salad bowl and biscuit barrel to Mr. Cyril Clarke, chief clerk, on his marriage.

The Stockport T.C. has appointed Mr. RALPH LOMAX as tramways electrical engineer, at a salary of £250 per annum, rising to a maximum of £300, with two pupils.

General.—Mr. J. DENNIS COALES, B.Sc., A.M.I.E.E. (from University College, Nottingham), has been appointed Senior Lecturer in Electrical Engineering at Birmingham University, in place of Dr. D. K. Morris, who has resigned. Mr. Coales is 31 years of age, and was educated in engineering at the Finsbury Technical College, where he subsequently became private assistant to Prof. Silvanus P. Thompson. After completing his course as a student at Finsbury, where he gained the Sessional Prize in Electrical Engineering in 1895, he entered the firm of Messrs. Crompton & Co., Ltd., and remained there for about a year, when he accepted Dr. Silvanus Thompson's offer to become his private assistant. With him Mr. Coales remained about five years, undertaking a good deal of practical work, and assisting in the experiments on electric traction by the Thompson-Walker surface contact system at Willesden. Then, as senior demonstrator in electrical engineering at the University College, Nottingham, he had charge of the laboratories, and of the electric lighting department. Mr. Coales planned and fitted out a new electrical engineering laboratory at Nottingham.

We understand that Prof. SCHUSTER, F.R.S., has resigned the chair of physics at the University of Manchester, where he has taught for more than 25 years. The resignation is to take effect at the end of the present session.

Our Cape Town correspondent informs us that Mr. F. D. LINGWOOD has been appointed Inspector of Electric Light Installations for the district controlled by the Frontier Fire Insurance Association, comprising East London, King William's Town, Queen's Town, Aliwal North, &c. Mr. Lingwood succeeds Mr. G. E. Sanders, who was recently appointed assistant electrical engineer to the Port Elizabeth Corporation.

According to an Indian Exchange, Mr. B. RAIKES has been appointed Electric Inspector for the purposes of the Indian Electricity Act, 1903, throughout the whole of Burma.

Owing to certain criticisms, the system of book-keeping at the Croydon Electricity Works is being revised, at the instance of the Borough Council, by a firm of chartered accountants. On their recommendation, Mr. E. J. FUSSELL, at present in charge of the gas department of the Nantwich Urban District Council, was appointed on Monday to reorganise and take charge of the accounts, stores books, &c., at a salary of £160, rising to £200.

MR. EDWARD T. STEINTHAL, A.M.I.E.E., informs us that he has commenced practice as a consulting electrical engineer at 33, Victoria Buildings, Deansgate, Manchester.

Obituary.—A large circle of those engaged in electrical engineering work will deeply regret to hear of the death, at the early age of 37, of Mr. CHARLES ANDREW BUSTARD, which took place on Friday last from acute pneumonia. Mr. Bustard was for the last four years in general charge of the erection work of the British Westinghouse Electric and Manufacturing Co., Ltd., for the London district, this work covering the Chelsea station and the numerous sub-stations of the Underground lines. He was born in Ohio, and was one of the earliest of the Pittsburg Westinghouse Electric Co.'s strenuous young men to settle in this country, where he had lived since 1898. His readiness at all times to impart a remarkably full knowledge of his department of electrical engineering, and a peculiarly amiable disposition, endeared him not only to his immediate *confrères*, but to everyone with whom he was brought into contact.

NEW COMPANIES REGISTERED.

Sanfil, Ltd. (91,494).—This company was registered on January 2nd, with a capital of £5,000 in 1s. shares, to carry on the business of contractors, bankers, capitalists, financiers, concessionaires, electrical and general engineers, tramways, railway, telegraph and telephone proprietors, suppliers of electric light, heat and power, &c. The first subscribers (each with one share) are:—A. J. Webb, 25, Monson Road, New Cross, S.E., clerk; C. T. C. Beecroft, 41, Moorgate Street, E.C., solicitor; C. J. Ketteridge, 117, Borough Road, S.E., clerk; A. J. Clarke, 46, Keston Road, East Dulwich, clerk; G. Pells, 4, Denmark Villas, Wilmot Road, Leyton, stenographer; A. Hill, 12, Tremadoc Road, Clapham, S.W., clerk: and F. K. May, 11, Claremont Road, Leyton, stenographer. No initial public issue. The number of directors is not to be less than three or more than seven; the subscribers are to appoint the first; qualification, 500 ordinary shares; remuneration (except managing director), 5 per cent. of the profits available for distribution, divisible (maximum for each director £100). Registered office, 5 and 6, Winchester House, E.C.

ELECTRICITY SUPPLY ACCOUNTS.

Durban (Natal) Municipal Electricity Supply.

We deal this week with the returns of the Durban undertaking, for the year ended July 31st, 1906; they form a satisfactory record in spite of the continued depression in South Africa, although the income has not come up to the estimated amount. More economies have been effected during the year under review, and a 750-KW. alternator set (replacing one of 350 KW.), and a boiler of 14,000 lb. evaporative capacity, fitted with superheater and mechanical stoker (replacing two of 7,000 lb. each), have been added; the economies have effected a saving of ·24d. in generating costs, the cost being now ·86d., as against 1·10d. last year. Additions have been made to the distribution system to the extent of 5 miles of underground mains, and 4½ miles of bare overhead mains, and the public lighting has been increased by five arcs and 141 incandescent lamps.

Though private consumers have increased by 14 per cent., there having been 446 new ones added, the units sold have remained practically the same, which is owing in a measure to 427 premises being temporarily disconnected through trade depression. The average consumption per consumer works out about 30 units per month in summer, and 45 units in winter.

The financial result of a net profit of £8,070 is highly satisfactory.

The prices charged are:—Private lighting, 8d., less 15 per cent. for over 500 units per month, less 10 per cent. prompt cash; power, 1d. to 2d., plus a standing charge of from £3 to £5 per H.P. per annum; traction, 1d.; public arcs, £20 per annum; incandescents, £2 10s. per annum. The chief engineer is Mr. J. Roberts.

GENERAL STATEMENT.

For year ending July 31st, 1906.

Total capital expended	£239,576
Number of units sold—	
Private supply { lighting	1,519,490
Private supply { power	1,048,043
Public lighting	652,000
Traction	2,137,147
Total number of units sold	5,356,680
Equivalent No. of 8-C.P. lamps connected ...	147,834
H.P. of motors connected	1,204
Number of public lamps ... ... {	260 arc. 1,390 inc.
Traction load in KW.	1,000
Revenue account—	
Gross revenue	£74,450
„ expenditure	£34,270
„ profit	£40,181
Average inclusive price obtained per unit—	
Private supply { lighting	7·62d.
Private supply { power	1·96d.
Public lighting	3·19d.
Traction	1·01d.

REVENUE ACCOUNT FOR YEAR ENDING JULY 31ST, 1906.

Gross revenue	£74,450	= 3·34d. per unit.
Works and distribution costs (including public lighting) ...	£26,739	= 1·20d. „
Total working costs	£34,270	= 1·54d. „

PROFIT STATEMENT, 1906.

Interest on loans, &c.	£10,630
Sinking fund...	1,794
Special allowances	7,000
Suspense account	1,795
Depreciation...	10,000
Outstanding accounts	893
Balance on year's working (less bad debts) ...	8,069
Gross profit	£40,181

ELECTRIC TRAMWAY ACCOUNTS.

Durban (Natal) Municipal Tramways.

THE returns for the electric tramways system of the Corporation for the year ended July 31st, 1906, are as follows. The system has been in operation over four years, previous to which horse traction was in use. The combined power station supplies direct current at 550 volts, for which the Tramway Department is charged 1d. per unit. The manager is Mr. H. N. Thomas.

Particulars of Rolling Stock.—51 double-deck four-wheel cars; two sprinklers (one four-wheel, one bogie); one funeral car (and one trailer for natives); three stone wagons (four-wheel); six trailers (radial trucks).

Traffic statistics for—

	1905.	1906.
Car-miles	1,097,230	1,244,243
Passengers carried	11,848,191	11,883,118
„ „ per car-mile ...	10·73	9·55
Average fare per passenger ...	1·77d.	1·77d.
Traffic receipts per car-mile ...	19·31d.	16·90d.

During the past year the operating expenses were reduced from 9·9d. to 9·66d. per car-mile, but, owing to depression, the traffic has decreased.

The expenditure on maintenance has been heavy on overhead equipment, rolling stock and track, &c., amounting to a total of £13,511.

General Statement for Year ended July 31st, 1906.

Length of route	14¾ miles
„ „ track	25 „
Car-miles run	1,244,243
Passengers carried	11,883,118
Capital expenditure	£397,871
Traffic receipts	£87,638
Total „	£88,668
Working expenses	£50,168
Gross profit	£38,500
Income per car-mile	17d.
Working expenses per car-mile	9·66d.
Interest and sinking fund per car-mile	4d.
Total expenses per car-mile	13·66d.
Profit per car-mile	3·34d.
Cost of energy per car-mile	1·7d.
Average fare per passenger	1·77d.
Total number of units used	2,106,634
Units used per car-mile	1·7
Percentage of working expenses to receipts	57 %

Analysis of Operating Expenses per Car-Mile.

Power	1·69d.
Traffic	4·9d.
General	·47d.
Maintenance	2·6d.
Total	9·66d.

Profit Statement.

Total income	£88,668
Working expenses	50.168
Interest	17,121
Sinking funds	3,420
Depreciation	10,368
Accident insurance	1,000
Sundry accounts	5,000
Cost of loan	606
Net surplus	£985

CITY NOTES.

South Wales Electrical Power Distribution Co., Ltd.

A meeting of the debenture stock-holders of the above company convened by the debenture stock-holders committee, was held on Monday at Winchester House, Old Broad Street, for the purpose of considering the present position of the company.

Mr. Stanley Boulter, chairman of the committee, presided, and in opening the proceedings, said he must ask for their indulgence while he placed before them what he could only call a tale of woe. Speaking as to the inception of the company, he said that the Act of Parliament was passed on August 6th, 1900, and it empowered a company to be formed for the purpose of carrying on the powers of the South Wales Electrical Power Distribution Co. Judging from the information which they had obtained, and from their investigations so far, it might be safely said that the objects were laudable, and that if the company had been managed with prudence, it would also have afforded a profitable field for the enterprise of capital. The gentlemen who promoted the scheme were well known and highly respected men of business in South Wales, and the same remark applied to the first directors. The necessary capital was subscribed in 1902, and operations were commenced for building the power house, &c. In 1904 application was made to friends of his (the chairman) in London to know whether they would supply a certain amount of further capital which was required for the purpose of putting what was called the finishing touch upon the buildings and machinery, so as to get to work and to be able to make the profits which they anticipated, and Mr. G. Collis and Mr. R. Fleming were consulted as to whether they would be disposed to take part of this new capital themselves and advise their immediate friends to take a part also. Those gentlemen made a special investigation into the circumstances of the company as they existed at that time. Mr. E. Manville, a well-known electrical engineer, was employed to make a report and to ascertain whether the prospects of the undertaking were sufficiently favourable as to induce a further amount of capital being placed in the concern. That report was satisfactory, and upon the facts which were placed before him he estimated from a capital expenditure of £680,000 a net income of £60,000 a year might be relied on, and they were led to believe that the new money which was being put into the concern would be sufficient to realise those anticipations. Mr. Manville said in his report that the business then was being managed in a satisfactory manner. He admitted that everybody was liable to make mistakes, but he (the speaker) thought that Mr. Manville must have taken too favourable a view of the situation, because their investigations had showed them that nothing could have been more unfortunate than the management of the concern from the commencement. A sum of capital which approximated to £300,000 had evidently been lost, and management had been very largely the cause of that loss, and that being, so it seemed difficult to imagine how the management could have been satisfactory. However, a considerable amount of capital was found, and they understood that orders were given to put the concern into a prosperous condition. A few months after when they were looking forward to seeing something in the nature of a result the usual explanations were given by the directors—explanations which satisfied nobody probably but the people who gave them, and they could see no prospects of dividends on the capital being realised. The matter went on—various further explanations were given from time to time, until at the commencement of last year they were asked whether they could put more money into the concern as the expectations of those connected with the management had been disappointed. It was pointed out to them that it was urgently necessary that more money should be found if the company was to be kept afloat. That came as a bolt from the blue, and there was no inclinations to find any more money until further investigation was made. That investigation was made, and the circumstances of the case proved to be of a most unsatisfactory nature. They had one or two reports made, and they were met by the statement that nothing short of a very considerable amount of capital would be necessary to make the concern a paying undertaking. A few of them then formed themselves into a debenture-holders' committee, and the first thing they did was to ask Mr. Merz to inquire thoroughly into the matter. Mr. Merz went down to Cardiff and made every investigation, and he came to the conclusion that it was no use attempting to do anything with the business unless a large sum of money was found. The sum then mentioned was £500,000. That proposition involved very anxious consideration on the part of the Committee. The raising of the money was not the question so much as whether if it were raised the company could be placed on a sound commercial basis. A debenture-holders' meeting was held at the Cannon Street Hotel, and there Sir W. Lewis, who was one of the trustees for the debenture-holders, was in the chair, and his solicitor attended also. At that meeting they were surprised to find that the trustees had nothing much to tell them from their point of view, but one thing they did tell them which greatly astonished them, was that the trustees were not in a legal position—that there was no power to draw the trust deed which had been drawn, and, as a matter of fact, the trustees held no office at all. After that the debenture-holders' committee went to Cardiff and called a meeting of the largest colliery-owners and power-users in the district. They asked for a guarantee of 40,000 H.P. The meeting formed themselves into a committee, and they left the room hoping that the people in South Wales would be able to do what they asked, and they gave them to understand that if that was done the £500,000 would, in all probability, be forthcoming. That was in July. Things went on until November, when they met the consumers in London, and they frankly told them that there was no prospect of their being able to guarantee this 40,000 H.P., but that the most they could guarantee was 14,387 H.P. The committee had done everything they could to save the disgrace of stopping the works and allowing the whole of the capital to be lost. Some of the collieries that had been taking power from the company were going to withdraw their custom and put down their own installations. A circular was sent out to the creditors asking whether they would agree to accept preference shares for their debts, but out of a total of £81,824 only creditors representing £32,694 were willing to come into such a scheme. Under those circumstances they had come to the conclusion that it was idle to find any further capital for the concern. The people who were finding the money to-day were finding money for a derelict undertaking; as things were, it was hopeless to expect that any profits could come from the business. As to how the money had been lost, their investigations on the committee had not gone deeply into the past. They had spent about £2,500 in professional expenses to investigate the actual position to-day and to obtain advice as to the future, but he could tell them the position in a word. The capital raised up to the present time was £200,000 in debenture stock and £610,120 in shares, making a total of £810,120. The land had cost £4,970; buildings, £137,976; machinery, £254,486; mains, £213,890; transformers and motor-generators, £58,087; motors, £2,046; electrical instruments, £762—making a total of £672,217. The cost of obtaining the Acts of Parliament, preliminary work in connection with obtaining contracts and floating the company, including remuneration to the South Wales Electrical Power Distribution Co., Ltd., £79,236; cost of issuing capital, £59,617; administration and working expenses during construction and interest, £30,897; preliminary expenses, £1,841; net revenue account loss to date, £85,198, making a total of £899,006. It was very difficult to say what would be the upshot of the matter. The business was being carried on at the present time by the consumers who were connected with the station, and, of course, it would be a very serious thing for them if the station closed down. One of their difficulties was that the company was a statutory one. If it was a limited company it would be quite easy to appoint a receiver and protect the assets. The debenture-holders had the first claim on the property, whatever that claim might be worth.

Mr. Callender, of Callender's Cable and Construction Co., said it was absurd of the Committee to have sent out to the creditors a day or two before Christmas asking for a reply on December 29th

as to whether they would accept their debts in preference shares. In the case of his own company, he had only just been able to get their assent to the proposal.

Replying to a question, the CHAIRMAN said the Committee would be pleased to continue to do their best to watch over and protect the interests of the debenture-holders as far as possible.

A resolution to this end was carried, and it was also resolved to authorise the company to issue so many prior lien bonds as might be necessary to cover the expenses of the Committee, which the chairman said had so far amounted to about £2,500.

The British Westinghouse Co., Ltd.

THE report of the British Westinghouse Electric and Manufacturing Co., Ltd., for the year ended at July 31st, 1906, has at last been issued, and it is to be submitted at the seventh annual general meeting, which is to be held on Monday next, 14th inst., at Hamilton House, Victoria Embankment. This meeting will be of more interest than usual, as proposals, of which particulars appear below, are to come forward for drastically reducing the capital.

In their report the directors say that during the early part of the year under review, the contracts, carried over from the previous year, and certain other contracts, resulted in a considerable loss. "Since January, 1906, there has been almost a complete change in the methods and management of your company; manufacturing costs have been decreased, and the efficiency of the general organisation improved. Since the close of the financial year the orders taken show a large increase over the corresponding period of last year, and the trading results appear to warrant the conclusion that the business of the company has reached a turning point. A readjustment of trading territory has been negotiated with the American companies, and under the arrangements now made, the company has acquired the right to sell in South America and other markets. Offices have been opened in Buenos Ayres and Johannesburg, and reciprocal arrangements have been made with the American companies, which are expected to increase the volume of our business. The condition of the home electrical trade is at present very unsatisfactory, but your Foreign and Colonial business is growing rapidly. Since the export office was organised two years ago, your export business has increased over threefold, and is now equal to one-third of the total volume. The business and prospects of the company having taken a favourable turn, the directors have come to the conclusion, that the earliest opportunity should be taken to write down certain items in the balance-sheet, and to make special provision for depreciation and for reserve against contingencies. Proposals for securing these objects will accordingly be submitted to the meeting as special business. If these proposals be adopted, the effect will be, that while a large sum will be written off the preference and ordinary shares, the rate of dividend will be adjusted to compensate for the reduction in capital, and the company will be in a much better position to pay dividends, as and when earned. Your directors accordingly recommend the adoption of these proposals, which are set forth in the accompanying circular, and they hope that they will receive the support and co-operation of the shareholders in their efforts to develop and improve the business of the company. Debenture stock to the amount of £225,000, referred to in last year's report, has been taken up and paid for by the American Co., who have also advanced your company over £130,000 on open account."

Reference to the balance-sheet shows that during the year there has been additional expenditure under suspense account for "excess cost and experimental expenditures in the development of new types of apparatus," amounting to £79,987, making the total under this head £188,240. There was a balance against profit and loss account last year of £15,408. To this has now to be added £52,375 for interest on 4 per cent. mortgage debenture stock to July 31st, 1906, and on temporary loans, also £42,790 for adjustment of working assets, ascertained to date. From these items, however, there is deducted the sum of £7,568 for "trading profit for the year, including estimated profit accrued to date on contracts in progress, after providing for the expenses of management, maintenance of buildings, machinery, &c., and all other working charges," and a small sum for transfer fees, leaving the present balance against profit and loss account £102,943.

The auditors point out in their report that no proportion of the suspense account expenditure referred to above has been written off during the year. They also point out that in previous accounts the amount of the ascertained deficit on the adjustment of working assets has been taken into account before arriving at the result of the year's operations. The shares and debentures in other companies (£433,828) do not possess quotations on the Exchange, and are taken at cost. No provision has been made for depreciation of buildings, machinery and other assets.

In the "accompanying circular," the secretary, Mr. Arthur E. Scanes, briefly describes the nature of the directors' scheme for writing down the capital, for increasing the rate of dividends, and for increasing the board's borrowing powers. He says:—"In explanation of the necessity for the proposed reduction of capital, I am desired to draw your attention to the following facts:—The directors of the company have had under consideration the question of the value of its capital assets having regard to two facts, first, that owing to the development of the home electrical trade having been much slower than was anticipated, the scale of the works has so far proved to be too large; and second, that since the works were designed, there have been considerable changes in conditions of manufacture arising out of changes in types of apparatus. As a result of their deliberations the directors recommend, that, in the best interests of the company, a reduction in the capital to the extent of £1,375,000 be made. Of this amount it is proposed to devote the sum of £1,083,816 13s. 6d. to the writing down of patents and goodwill, works and equipment, material and stock in hand, &c., and to the provision of an adequate reserve in respect of developments, contracts and work in progress undertaken in previous years. It is proposed to devote the balance of £291,183 6s. 6d. to the extinction of the suspense account, and of the balance at the debit of profit and loss account. To meet the above reductions in the capital assets of the company, the directors recommend that the share capital be reduced by writing off £ per share from the 500,000 preference shares, and £5 per share from the 75,000 ordinary shares. At the same time, the directors recommend that the rate of dividend should be increased as follows:—On the preference shares from 6 per cent. to 10 per cent., and on the ordinary shares from 6 per cent. to 12 per cent., the division of any surplus profits between the two classes of shareholders remaining as at present—viz., one-fourth thereof among the preference and three-fourths among the ordinary shares. This would result in the preference shares being entitled to the same amount of preferential dividend as heretofore, and the ordinary shares to the same amount of dividend as at present payable on them, before any division of surplus profit is made between the two classes of shares. In the event of liquidation, the rights of the two classes of shares remain as at present, so that the preference shares shall first receive £5 per share before any distribution is made to the ordinary shares. The voting power now enjoyed by the respective classes of shares will not be affected."

Calcutta Electric Supply Corporation, Ltd.—The number of units delivered to consumers during the five weeks ended November 30th, 1906, were 397,437 compared with 318,157 units in the corresponding five weeks of 1905.

Globe Telegraph and Trust Co., Ltd.—A quarterly interim dividend of 2s. per share on the ordinary shares is announced.

Douglas Southern Electric Tramways, Ltd.—The annual meeting was held in Manchester recently, Mr. T. J. Hutchinson presiding. The report stated that the company's season consisted this year of 121 days, as against 114 days last season; the mileage run was 34,133, as against 33,313 last year. The season has been a record one, and the line has received its share of patronage. The passengers carried were 229,316, against 210,298, and there was once more a total absence of accident to passengers, plant, or rolling stock. The total receipts for the season were £5,542, as against £5,106. The net profit for the year was £2,137, as against £1,744. The directors recommend the full dividend of 7 per cent. upon the preference shares, and 1¼ per cent. upon the ordinary shares, leaving £344 to carry forward. The report was adopted.

Victoria Falls Power Co., Ltd.—It may be of interest to some of our readers to learn that the Victoria Falls Power scheme, which was so persistently and extensively belauded in the Press, was met by a very weak response from the British investing public. We are told that the underwriters had to take considerably more than 80 per cent. of the issue.

Fife Electric Power Co.—The annual general meeting of this company was held at Edinburgh recently, Mr. R. Russell presiding. The report and accounts for last year were submitted and approved. The report referred to Mr. R. E. Walker's recent resignation of the office of chairman, and contained an expression of thanks for his services to the company. Mr. Walker continues to act as an ordinary director. Mr. William Robertson, Dunfermline, and Mr. A. R. Young, Kirkcaldy, were re-elected as directors. Owing to business engagements the other retiring director—Mr. David Russell, of Inchdairnie—declined re-election.

Bahia Tramway, Light and Power Co., Ltd.—The *Times* announces that a general meeting of holders of 5 per cent. gold debentures will be held at 46, Threadneedle Street, London, on February 5th, for the purpose of considering a resolution authorising the issue of further debentures not exceeding $4,000,000 for the purpose of extensions and developments in the company's business.

Buenos Ayres Grand National Tramways Co., Ltd.—In his speech to the shareholders last week, Mr. J. Irving Courtenay referred to his recent visit to Buenos Ayres with Mr. C. M. Rose. They went over the whole of the combined systems now worked under one management, and inspected the various stations. The work of electrification was being thoroughly well done. On November 30th last the length of line converted to electric traction was 69½ miles. Rails and other materials for a further 33 miles had already been shipped to Buenos Ayres, and the balance required to complete the conversion of the entire system would be delivered during the next three or four months. When the joint system was completed it would consist of over 113 miles of line. The traffics of the current financial year were quite up to the directors' expectations. His visit to Buenos Ayres had confirmed the view he had previously formed of the good results to be anticipated when the electrification was completed.

MARKET QUOTATIONS.

Wednesday, January 9th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal)	per ton	£33 10	..
a ,, ,,	per ton	£30	..
a Bleaching powder	per ton	£5 10	..
a Bisulphide of Carbon	per ton	£18	..
a Borax	per ton	£15	..
a Benzole (90 %)	per gal.	10¾d.	..
a ,, (50 %)	per gal.	1/-	..
a Copper Sulphate	per ton	£32 10	..
a Lead, Nitrate	per ton	£34 10	..
a ,, White Sugar	per ton	£25	..
a ,, Peroxide	per ton	£32	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90 % at 160° C)	per gal.	5/6	..
a Potassium Bichromate, in casks	per lb.	8½d.	..
a Potash, Caustic (75/80 %)	per ton	£20	..
a Potassium Cyanide	per lb.	7½d.	..
a Shellac	per cwt.	220/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %	per ton	£10 15	..
a ,, Crystals	per ton	£8 5	..
a Sodium Bichromate, casks	per lb.	3d.	..
a ,, Cyanide (basis 100 %)	per lb.	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£200	..
b ,, Wire, in ton lots	per ton	£220	..
b ,, Sheet, in ton lots	per ton	£210	..
p Babbitt's metal ingots	per ton	£61 to £203	dec.
c Brass (rolled metal 2" to 12") basis	per lb.	11¼d.	..
c ,, Tube (brazed)	per lb.	1/0½	..
c ,, ,, (solid drawn)	per lb.	11¼d.	..
c ,, Wire, basis	per lb.	11d.	..
c Copper Tubes (brazed)	per lb.	1/2½	..
c ,, ,, (solid drawn)	per lb.	1/2½	..
g Copper Bars (best selected)	per ton	£124	..
g Copper Sheet	per ton	£124	..
g ,, Rod	per ton	£124	..
e ,, (Electrolytic) Bars	per ton	£115	..
e ,, ,, Sheets	per ton	£127	..
e ,, ,, Rod	per ton	£117	..
e ,, ,, H.C. Wire	per lb.	1/1½	..
f Ebonite Rod	per lb.	3/3	..
f ,, Sheet	per lb.	3/-	..
n German Silver Wire	per lb.	1/8	..
h Gutta-percha, fine	per lb.	6/- to 7/-	..
h India-rubber, Para fine	per lb.	5/0½ to 5/2½	dec.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	60/9	..
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8	per ton	£9 15	..
g Lead, English Ingot	per ton	£20 to £20 2 6	2/6 dec.
g ,, ,, Sheet	per ton	£21 10 to £21 12 6	2/6 dec.
m Manganin Wire No. 28	per lb.	8/	..
g Mercury	per bot.	£7	..
d Mica (in original cases) small	per lb.	6d. to 1/-	..
d ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, large	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/4½ to 1/6½	..
p ,, rolled bars & rods	per lb.	1/5½ to 1/6½	..
p ,, ,, strip & sheet	per lb.	1/6 to 1/10	..
o Platinum	per oz.	150/-	..
e Silicium Bronze Wire	per lb.	1/3	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£68	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block (English)	per ton	£129 10 to £130 10	70/- dec.
n ,, Wire, Nos. 1 to 16	per lb.	2/4	..
p White Anti-friction Metals— "White Ant" brand	per ton	£61 to £88	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£31 15	..

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, G.P. and Teleg. Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.

Electrical Equipment of the "Hibernia."—According to a correspondent of the *Globe*, the electrical equipment of the *Hibernia*, the eighth and last of the *King Edward VII* class, is more comprehensive than that of any other British warship excepting the *Dreadnought*, over 80 electric motors being installed. "The purposes for which the motors are used cover practically everything in the way of power work, with the exception of the main and principal auxiliary machinery. They are even applied to the well-equipped bakery and cooking services, which are capable of keeping the ship's company supplied with newly-baked bread and well-cooked meals." The heavy guns are discharged by motor-generators, in place of the electric batteries in the sister ships.

STOCKS AND SHARES.

Tuesday Evening.

Stock Exchange markets are striving desperately hard to live up to the prophecies prevalent at the end of last year, when everybody declared that everything would go better in the New Year; and, to some extent, markets are succeeding in their laudable ambition. Excelsior is written upon various departments, especially those connected with investment securities. Several Home Railway stocks have enjoyed unwonted strength, and the talk of early reduction in the Bank Rate has caused Consols to mildly rally their various satellites.

It is very hard to have to mention strength in Railway stocks, and yet be unable to include Electrical Railway issues as coming into the same category. City and South London Ordinary stock has risen a point to 44, the advance being due to the approach of the dividend, but Central London Deferred is down a similar sum to 72½. For the latter half of 1905 the City and South London paid at the rate of 1⅞ per cent., and for the first half of 1906 the dividend was at the rate of 2¼ per cent. The Central London paid 4 per cent. on its three classes of Ordinary for 1905, and the Deferred, of course, carries the whole 12 months' distribution, which is payable annually. The Waterloo and City Company has now ceased to have a separate existence.

Piccadilly Debenture is 90½, Charing Cross Debenture 86½ (both being *ex* dividend), and Bakerloo Debenture 97. Metropolitan at 59½, and Districts at 19 have not altered much so far this year. There is still a tip to buy Districts, and we mention this in case anyone should be so rash as to think of doing so.

The British Westinghouse report, a dismal affair, has caused no alteration in the price of the shares, or of the Debenture stock; the latter is now *ex* dividend. In the market the only comment we have heard upon the scheme is that it will "clean up the balance-sheet a bit."

Electricity Supply shares are slightly better. Perhaps the presentation of Bills for electric light supplied to the harassed householder has sent him investing what little cash remains after the Christmas accounts are paid in the electricity department of the Stock Exchange. London Electric Ordinary have gained ⅛ at 2⅛, and so have Westminster Preference at 5⅜. A rise of 10s. makes Metropolitan Ordinary 8, and the Preference at 5¼ are a little better. Notting Hill shares, however, shed 10s., and County of Durham Preference ¼. A further call of £1 per share is being made on the Ordinary shares of the County of Durham Company, which will bring the value up to £4 per share paid.

Tramway shares are mostly on the up-grade once more. Anglo-Argentine Ordinary at 7⅛, and the Preference at 5⅛, are higher, despite the death of Mr. H. Doughty Browne, chairman of the company. The late Mr. Browne was an old and greatly respected member of the Stock Exchange. We hear that another member is now anxious to obtain a seat upon the company's directorate. Buenos Ayres and Belgrano Ordinary at 3⅜ are 10s. firmer, and there are rumours of working agreements between the concerns. Calcutta Trams show ½ rise at 8½. British Columbia Electric Railway Deferred is 2 points better. There was fresh weakness in British Electric Traction shares, the Ordinary falling to 4¼ and the Preference to 8¼. But the Ordinary recovered its decline on Tuesday.

Rumours of an excellent report, and possibly increased dividend, caused National Telephone Deferred to spurt 3½ to 110, while the Preferred sympathetically improved a point to 109, and the Third Preference ⅛ to 5¼. United River Plate Telephone shares participated in the strength of Argentine issues generally, at 7⅛ showing the addition of the fraction.

Telegraph stocks on the whole are good. Eastern Ordinary rose 1, and so did Anglo-American Ordinary and Preferred. Western Telegraphs are ⅛ better at 13⅞, and Direct United States Cable at 16 are ¼ up. West India and Panama First Preference shares declined, and Anglo-American Deferred, despite the rise in the senior issues, has eased off a shade. The dividend is looked for on the 18th or 25th inst. The Trust Companies' securities are unchanged.

Willans & Robinson Preference are 3¼, nearly 10s. a share better since the quiet buying of shrewd people was noticed here as a hint worth having. Curiously enough, the Debenture dropped to 75½, but the price is very nominal. Other alterations in the manufacturing list include 10s. fall in India-Rubber shares, said to be due to the rise in the price of the raw material, and small improvements in Crompton Preference shares and Debenture stock.

At Monday's meeting of the South Wales Electric Power Distribution Company a state of affairs was disclosed which brought forth scathing comment from the other side of the directors' table. Some of the statements made appeared almost incredible, and the recital of various examples of management, or mismanagement, left little room for doubt as to why the company has arrived at its present deplorable pass.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last four years.				Closing Quotations Jan. 1st.	Closing Quotations Jan. 8th.	Business done week ended Jan. 8th, 1907.		Rise + or Fall —
			1902.	1903.	1904.	1905.			Highest	Lowest.	
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3 — 3¼	3 — 3½	..	..	..
149,600	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	5 %	86 — 91 xd	88 — 91	90¾	..	+1
660,660	Anglo-American Telegraph	Stock	60/6	61s.	2½%	3½%	67½ — 69	68 — 70	68½	..	+1
3,169,670	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5½%	6 %	108 —109½	109½ —110½	110½	109	+1
3,169,670	Do. do. do. Deferred	Stock	1/-	2s.	Nil	½%	27½ — 28	27½ — 27¾	28⅜	27½	— ½
60,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	..	..	..	101 —103	101 —103	..	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	8 %	6½ — 7½	6½ — 7½	7⅜	..	..
2,097,680	Commercial Cable Stlng. 600 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	96 — 98 xd	96 — 98	97½	96	..
16,000	Cuba Telegraph	10	6½%	10 %	5 %	5 %	8½ — 9	8½ — 9	..	..	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %	17 — 18	17 — 18	..	..	..
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅝ — 3¾	3⅝ — 3¾	..	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	9 — 9½	9 — 9½	..	..	..
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100 —103	98 —101 xd	..	..	..
60,710‡	Direct United States Cable	20	3½%	3 %	3½%	4½%	15½ — 16	15⅞ — 16¼	16⅛	15⅝	+ ⅛
60,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	99 —101 xd	99 —101	..	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	134 —139	135 —140	139½	137	+1
2,000,000	Do. 8½ % Pref. Stock	100	8½%	8½%	8½%	8½%	87 — 89	86½ — 88½	88	86½	— ½
1,996,706	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	105 —107	105 —107	106½	105½	..
800,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	13½ — 13⅝	13½ — 13⅝	13⅝	13⅜	..
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	105½ —107½	105½ —107½	..	..	..
295,400	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —101	99½ —101½	..	..	+ ½
200,000‡	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..
181,127	Globe Telegraph and Trust	10	£3	5s%	5s%	5s%	10 — 10½	10 — 10⅞	10⅝	10½	..
181,127	Do. do. 6 % Pref	10	6 %	6 %	6 %	6 %	14 — 14½	14 — 14⅝	14⅝	14½	..
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	24%	35½ — 37½	35½ — 37½	36½	..	..
33,500	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	99 —101 xd	99 —101	..	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	18 %	13 %	58 — 60	58 — 60	..	..	..
226,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	⅛ — ⅛	⅛ — ⅛	..	..	..
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	3 %	4 %	5 %	1 — 1⅛	1 — 1⅛	..	..	..
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	¾ — 1	¾ — 1	..	..	..
2 225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	107 —109	108 — 110	109½	108⅝	+1
2,225 000	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %	105½—107½	109 — 111	110½	106⅝	+3½
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	11 — 13	11 — 13	..	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10 — 12	10 — 12	11¼	..	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅛ — 5⅝	5⅛ — 5⅝	5⅝	5⅛	+ ⅛
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	94½ — 96½ xd	95½ — 97½	96½	95½	+1
1,689,598	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	100 —102 xd	100 —102	101½	..	..
179,318	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6 %	6½%	6½%	7½%	1½ — 1⅝	1½ — 1⅝	..	..	..
50,000	Do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1⅛ — 1½	1⅛ — 1½	..	..	..
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	..	4 %	95 — 97 xd	95 — 97	97	96½	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	98 —101 xd	98 —101	..	..	..
11,839‡	Reuter's	8	5 %	5 %	5 %	5 %	7½ — 7⅝	7½ — 7⅝	7⅝	7⅜	..
60,000	Telephone Co. of Egypt, 4½ % Deb. Red. ..	100	..	..	..	4½%	99 —102 xd	99 —102	..	..	..
8,167	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	126 —129	126 —129	126½	..	..
80,000	United River Plate Telephone	5	7 %	8 %	8 %	8 %	6⅞ — 7⅛ xd	6⅞ — 7⅛	..	..	+ ⅛
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	6¼ — 6⅝ xd	6¼ — 6⅝	..	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	108 —111 xd	108 —111	..	..	..
15,609‡	West African Telegraph, Shares	10	2 %	4 %	4½%	4 %	10 — 10½	10 — 10½	..	..	..
80,008	W. Coast of America, 1 to 80,000 & 53,001 to 53,008	2½	Nil	Nil	Nil	Nil	⅜ — ½	⅜ — ½	..	..	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	100½—103½	98½ —101½ xd	..	..	..
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980 ..	10	7 %	7 %	7 %	7 %	13½ — 14 xd	13⅜ — 14⅛	14	13⅞	+ ⅛
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	99 —102 xd	99½—102½	101½	101	+ ½
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	½ — ⅝	½ — ⅝	..	..	..
34,563	Do. do. 6 % Cum. 1st Pref.	10	7 %*	7 %*	6 %	5 %	7½ — 7⅝	7½ — 7⅝	7⅝	7⅛	— ⅛
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	5½ — 6½	5½ — 6½	..	..	..
80,000‡	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	99 —102 xd	99 —102	..	..	..

Including arrears.

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, Nos. 260,008 to 510,007, and 560,008 to 580,007	5	..	..	8 %	8 %	7⅞— 7⅞	7¹⁵⁄₁₆— 7¹⁵⁄₁₆	7¹⁵⁄₁₆	7¹¹⁄₁₆	+ ⅛
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	5½— 5⅝xd	5¹³⁄₁₆— 5¹⁵⁄₁₆	5¹⁵⁄₁₆	5⅞	+ ⅛
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	126 —139 xd	126 —139	..	..	..
986,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	102 —104 xd	104 —106	..	..	+2
880,000	Babcock & Wilcox, 1 to 880,000	1	..	17 %	20 %	20 %	3⅞— 4⅛	3⅞— 4⅛	81/-	79/4½	..
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1⅝— 1¹³⁄₁₆	1⅝— 1¹³⁄₁₆	..	..	..
85,000	British Aluminium, Ord., 2,001 to 40,000	5	..	..	7 %	7 %	6— 6½	6— 6½	6⅜	..	..
40,000	Do. do. 7 % Cum. Pref..	5	Nil	Nil	7 %	7 %	6½— 6⅝	6½— 6⅝	6⅝	6⅝	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	6 %	6 %	5¼— 5⅜	5¼— 5⅜	..	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	4 %	4 %	4 — 4¼	4 — 4¼	..	..	..
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	101 —105	101 —105	..	..	..
800,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	..	..	100 —103	100 —103	..	..	..
400,000	British Columbia E. Rail Def. Ord. Stock	100	..	6 %	6 %	6 %	127 —132	129 —134	132½	132	+2
400,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	5 %	108 —112	110 —114	109¾	..	+2
800,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	107 —110	108 —112	110	..	+1½
238,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	102 —105	102 —105	..	..	..
250,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	102 —105	103 —106	104¾	..	+1
188,801	British Electric Traction	10	3 %	6 %	6 %	3 %	4½ — 4⅝	4½ — 4⅝	90/-	82/6	..
161,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %	8¼ — 8⅜	8 — 8¼	8⅛	8⅛	— ⅛
1,448,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	108 —111	108 —111	110	..	..
410,178	Do. do. 4½ % 2nd Deb. Stock ..	100	..	..	4½%	4½%	85 — 88	85 — 88	86⅜	85½	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %	6¼— 7	6¼— 7	..	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅝— 6¼	5⅝— 6¼	5⅝	..	..
600,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	100 —103 xd	100 —103	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	94 — 98	94 — 98 xd	..	..	..
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1⅜— 1⅞	1⅜— 1⅞	38/9	35/-	..
1,016,358	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	73 — 77	71 — 75 xd	..	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	⅝— ¾	⅝— ¾	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	2½%	⅞— 1	⅞— 1	..	..	..
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	6 %	1⅜— 1⅞	1⅜— 1⅞	..	..	..
125,000‡	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	95 — 97	95 — 97	..	..	..
125,000‡	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	80 — 83 xd	80 — 83	..	..	..
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	3 %	3 — 3¼	3½ — 4	77/6	69/4½	+ ⅛
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	6 %	5¼ — 5⅝	5¼ — 5⅝	5⅝	5	..
27,500	Do "B" do. 1 to 27,500	5	..	6 %	6 %	6 %	4⅝ — 5¼	4⅝ — 5¼	..	..	..
313,200	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	104 —106 xd	104 —106	..	..	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	101 —104 xd	101 —104	102	..	..
105,000	Calcutta Trams., 1 to 105,000	5	..	2 %	8 %	8 %	7⅞— 8⅜	7⅞— 8⅜	..	..	+ ⅛
82,610	Do. 105,001 to 187,610	5	..	..	..	8 %	7⅞— 8¼xd	7⅞— 8¼	..	..	..
30,000	Do. 5 % Cum. Pref., Nos. 1 to 29,390	..	..	..	..	..	5¼— 5⅝xd	5¼— 5⅝	..	..	..
860,000	Do. 4½ % 1st Deb. Stock	100	..	4½%	4½%	4½%	103 —106 xd	103 —106	..	..	..
85,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	15%	9½ — 10⅛	9½ — 10⅛	10⅛	9²³⁄₃₂	..
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	106 —108 xd	106 —108	..	..	..
491,222	Cape E. Trams., 1 to 491,222	1	15 %	10 %	5 %	Nil	⅞— 1	⅞— 1	10/9	10/6	..
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	6 %	1⅛— 1³²⁄₃₂	1⅛— 1³²⁄₃₂	22/6	..	..
224,988	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	97 —102	97 —102	..	..	..
1,911,568	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	82 — 84	82 — 84	82¾	..	..
544,216	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	4 %	98 — 100	98 —100	..	..	..
544,216	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	72 — 75	71 — 74	72¾	72½	— 1
1,480,000	City and South London Railway	Stock	3½%	3½%	3½%	3½%	42 — 44	43 — 45	44½	43½	+ 1
85,000	Crompton & Co., Nos. 1 to 85,000	2	5 %	2½%	2½%	2½%	1½— 1⅝	1⅝— 1⅞	86/3	84/6½	..
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 999 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	94 — 97	93 — 96	..	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends. ‖ And bonus of 10s. ¶ From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued.)*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1903.	1903.	1904.	1905.	Closing Quotations Jan. 1st.	Closing Quotations Jan. 8th.	Business done week ended Jan. 8th, 1907. Highest	Lowest.	Rise + or Fall—
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	..	10 %	10 %	1⅜ — 1⅝	1 7/16 — 1 11/16	..	..	+ 1
805,000	Do. do. 6 % Cum. Pref., 1 to 805,000	1	..	6 %	6 %	6 %	1⅜ — 1½	1⅜ — 1½	..	..	..
294,150	Do. do. 4½ % Deb. Stock	100	..	4½ %	4½ %	4½ %	101 —104 xd	101 —104 xd	..	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	10	..	5½ %	6 %	6 %	14 — 15	14 — 15	..	..	..
59,987	Do. 6% Pref. between 1 and 60,000	10	..	6 %	6 %	6 %	14 — 15	14 — 15	..	..	..
99,261	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,261	5	Nil	Nil	2½ %	4⅛ %	1⅜ — 1⅝	1⅜ — 1⅝	28/1½	..	..
17,189	Do. "A" shares, 01—017,189	5	Nil	Nil	2½ %	4⅛ %	2¼ — 2⅝	2¼ — 2⅝	..	..	..
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	85 — 87 xd	85 — 87 xd	..	..	..
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	90 — 95	90 — 95	..	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	Nil	Nil	1/16 — 7/16	1/16 — 7/16	..	..	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	7 %	7 %	7 %	7 %	1½ — 2	1½ — 2 1/16	..	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	83 — 86	83 — 86	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	8 5/16 — 8 9/16 xd	8 5/16 — 8 9/16 xd	..	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	94 — 97	94 — 97	..	..	..
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	..	3 %	4 %	4 %	3½ — 3⅝	3½ — 3⅝	72/6	..	..
96,000	Greenwood & Batley 7 % Cum. Pref.	10	..	7 %	7 %	7 %	10½ — 10⅝	10½ — 10⅝	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	..	5 %	5 %	5 %	102 —103	102 —103	..	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	20 %	15 %	15 %	15 %	11 — 12	11 — 12	11⅜	11⅛	..
200,000	Do. do. 4½ % Pref.	5	4½ %	4½ %	4½ %	4½ %	5 3/16 — 5 5/16	5 3/16 — 5 5/16	5 11/32	..	..
150,000	Do. do. 4½ Mort. Deb. Stock	Stock	4½ %	4½ %	4½ %	4½ %	106 —108	106 —108	..	..	..
60,000	India-Rubber, Gutta-Percha & Telegraph Works..	10	10 %	10%	5 %	10%	16 — 17 xd	15½ — 16½ xd	16⅛	15⅝	..
37,500	†Liverpool Overhead Railway, Ord.	10	1⅛%	1⅛%	1½ %	Nil	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	6 — 7	6 — 7	..	..	—1
600,070	London United Trams (1901), 1 to 50,007	10	..	8 %	6 %	3 %	8½ — 9	7½ — 8	..	..	..
899,930	Do. do. 60,008 to 100,000 (£6 paid)	10	..	8 %	6 %	3 %	3⅝ — 4⅛	3⅝ — 4⅛	..	..	..
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	..	5 %	5 %	5 %	8⅜ — 9⅛ xd	8⅜ — 9⅛ xd	..	..	..
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	86 — 91 xd	86 — 91 xd	88⅜	87	..
314,016	Metropolitan Electric Trams, Defd.	1	Ni	Nil	Nil	3 %	1/16 — 1/8	1/16 — 1/8	..	..	..
500,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	29/32 — 30/32	29/32 — 30/32	16/9	..	..
850,000	Do. 4½ % Deb. Stock Red.	100	..	..	4½%	4½%	95 — 98 xd	95 — 98 xd	..	..	..
30,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 50,000	5	..	..	6 %	6 %	4 3/16 — 4 5/16	4 3/16 — 4 5/16	..	..	..
24,500	Potteries E. Tro., 20,001 to 40,000 & 50,001 to 54,500	10	..	5 %	6 %	6 %	6 — 7	6 — 7	..	..	..
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	..	5 %	5 %	5 %	7 — 8	7 — 8	..	..	..
245,000	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	98¼—101½	98½—101 1/16	99½	..	..
87,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	15 %	30 — 32	30 — 32	30¾	..	..
150,000‖	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	100 —103	99 —102 xd	..	..	..
8,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	8) — 91	8) — 91	..	..	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	8⅓%	3 %	Nil	Nil	1 — 1⅛	1 — 1⅛	20/-	..	..
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	5	..	6 %	Nil	Nil	2⅞ — 3⅛	3 — 3⅛	63/9	..	+ 1/16
246,574	Do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	74 — 79	73 — 78	73½	..	—1

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	..	5 %	5⅛%	4 %§	5 — 5⅛	5 — 5⅛	..	..	..
70,000	Do. do. 4½ % 1st. deb. stock	100	..	4½%	4½%	4½%	99 —101	99 —101	..	..	..
29,798	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	8 %	10 %	10 %	10 %	8 — 9	8 — 9	..	..	..
40,202	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7⅛ — 8	7⅛ — 8	7⅞	..	..
336,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	101 —104	101 —104	..	..	..
80,000	Charing Cross and Strand Electricity Supply	5	10 %	8 %	8 %	5 %	3½ — 4⅛	3½ — 4⅛	73/9	..	..
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4⅛ — 4⅜	4⅛ — 4⅜	82/6	..	..
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅝ — 4⅛	3⅝ — 4	73/9	72/6	— 1/8
427,400	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	100 —103 xd	100 —103	99½	..	..
49,436	Chelsea Electricity Supply, Ord.	5	4½%	5½%	6 %	6 %	5⅛ — 5⅜	5⅛ — 5⅜	5⅛	..	..
176,000‖	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	106 —109	104 —107	104¾	..	—2
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	6 %	9⅛ — 10⅛	9⅛ — 10⅛	9 1/8	..	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11 — 12	11 — 12	11⅞	10⅞	..
400,000‖	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 —126	121 —124	122½	..	—2
800,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	100 —103	98 —101	..	..	—2
40,000	County of Durham Electrical Power, Ord.	2	4 %	4 %	£3 7 0	4 %	2 1/16 — 3 3/16	2 1/16 — 3 3/16	..	..	..
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	5 — 5⅛	4⅞ — 5⅛	..	..	— ⅛
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½ %	5 %	7⅛ — 8⅛	7⅛ — 8⅛	7⅞	..	..
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10⅛ — 11⅛	10⅞ — 11⅛	11⅛	..	..
400,000‖	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	107 —110	105 —108	107	106⅛	—2
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	98 —101	98 —101	99½	..	..
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	4 %	2⅜ — 3⅛	2⅛ — 3⅛	..	..	..
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..
350,000	do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	99 —102	98 —101	99	..	—1
10,000	Folkestone, 1 to 10,000	5	..	5½%	5½%	5½%	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	..	5 %	4⅛ — 5⅜	4⅛ — 5⅜	..	..	..
90,000	Do. 4½ % 1st. Deb. Stock	100	..	4½%	4½%	4½%	99 —102	99 —102	..	..	..
13,000	Hove, 1 to 13,000	5	..	8½%	8½%	9 %	7⅜ — 8⅛	7⅜ — 8⅛	..	..	..
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	12%	12 %	10 %	9⅛ — 10⅛	9⅛ — 10⅛	..	..	..
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	8	Nil	Nil	3 %	4 %	1⅜ — 2⅛	1⅞ — 2⅛	42/6	..	+ ⅛
70,000	Do. do. 6 % Pref...	5	6 %	6 %	6 %	6 %	4⅜ — 5⅛	4⅜ — 5⅛	5 1/32	..	..
674,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	95 — 98 xd	95 — 98	..	..	..
200,000	Metropolitan Electric Supply, 1 to 100,000	5	7½%	8½%	10 %	10 %	7 — 8	7⅛ — 8⅛	7 1/16	7⅛	+ ⅛
76,121	Do. 4½ % Cum. Pref. 1—71,106, £8 pd.	5	4½%	4½%	4½%	4½%	5⅛ — 5⅜	5⅛ — 5⅜ xd	..	..	..
220,000‖	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	108 —112	106 —110	..	..	—2
250,000‖	Do. 3¾ % Mort. Deben. Stock Redem.	Stock	3¾%	3¾%	3¾%	3¾%	95 — 97	94 — 96	..	..	—1
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	98 —101	96 — 99	..	..	—2
67,991	Newcastle-on-Tyne	5	..	8 %	8 %	8 %	7⅞ — 8	7⅞ — 8	..	..	..
75,000	Do. 5 % Pref., 1 to 75,000	5	..	5%	5 %	5 %	5⅝ — 6⅛	5⅝ — 6⅛	..	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	7½%	13½ — 14½	13 — 14	13 5/16	..	— ⅛
64,000	Do. do. 4 % 1st Mort.Deb...	100	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..
20,000	Oxford, 1 to 96 and 407 to 20,310	5	..	6½%	7 %	7 %	6 — 6½	6 — 6½	..	..	..
50,000	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	98 —100	98 —100	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	12½%	9½ — 10½	9½ — 10½	..	..	..
20,000	Do. do. 7 % Pref. 20,001 to 40,000	5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	..	..	..
150,000‖	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	95 — 97	94 — 96	..	..	—1
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	4 %	4 %	1½ — 2½	1½ — 2½	..	..	..
60,000	Do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	73 — 77	73 — 77	..	..	..
65,000	South London Electricity Supply, Ord.	5	12½%	8 %	4 %	4 %	2⅜ — 3⅛	2⅜ — 3⅛	60/-	57/6	..
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	Nil	Nil	2½%	1/16 — 1/8	1/16 — 3/16	..	..	+ 1/16
117,968	Do. Do. 7 % Pref.	1	Nil	7 %	7 %	7 %	1⅛ — 1⅜	1⅛ — 1⅜	26/-	..	..
200,000	Do. Do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	102 —105	102 —105	103¾	..	..
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	3½ — 3⅝	3⅝ — 3⅝	..	..	..
50,000	Do. do. 5 % Cum. Pref.	5	5 %	6 %	5 %	5 %	4 — 4½	4 — 4½	85/-	..	..
230,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½%	4½%	99 —102	99 —102	..	..	..
‖10,000	Westminster Electric Supply, Ord.	5	12 %	12½%	14 %	13 %	9 — 10	9 — 10	9 9/16	9⅜	..
81,279	Do do. 4½ % Cum. Pref. (Originally 5%—Red. to 4½ % from 31st Dec., 1905.	5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜ xd	5 5/16	5 5/16	..

Shares not officially quoted:—Mackay Companies, ord., 74—76. Pref. 70—72.
† Unless otherwise stated all shares are fully paid. § Interim dividends.

Bank rate of discount 6 per cent. October 19th, 1906.

MILAN—A RETROSPECT.

It is somewhat the fashion to sneer at and disparage exhibitions among those who pose as the elect of the markets of the world, and who act as if there were no such contingency as the dissipation of business and its gradual extinction in the hands of those who take competition lying down. It is all very well, they say, for firms who are on the make to exhibit, and for nations who are struggling for a share in the general trade of the earth to participate; we who have an established reputation among faithful clients, and who have more orders on our books than we can execute, have no necessity to show, and it is money in our pockets to keep away. Thereupon they do keep away, and with them many minor firms refrain from exhibiting who possess no such specious excuse for absenting themselves, and Great Britain makes herself once more chiefly conspicuous by her absence, and allows competitors to allege, with some show of truth, that the old lady is withdrawing from business, and thanks no one for giving her fresh orders. There is, however, an uneasy feeling at the back of the mind of even those who have the least necessity, in their own opinion, to participate at international shows, that there may be something to be said for the view which foreigners unquestionably take of exhibitions.

"I know that the Germans are keen business people and that they are practical enough in everything connected with commerce, and that, although they take many risks which I, for one, should not care to take, they have made it pay very well, and are serving many of the customers which I used to serve, and I know they exhibit extensively, still it is no use pretending I hold with exhibitions for I don't, and I don't believe it pays to exhibit." "The French, too, exhibit more than any one, yes! and they make the best shows of any one, but then they have a very efficient exhibitions' organisation, and it has got to make work for itself; then they are not competitors of ours that one needs to be afraid of, hurrah! for the 'Entente Cordiale!'" "What can you do in Italy, it is protected up to the hilt, you haven't got a chance of pushing any of your goods there even if you do show, for the duties kill them! Yes! I know that protection hits others besides us, and that our goods pay the same as those of our competitors; but I don't hold with trying to do business in protectionist countries, best keep away till they come to their senses—free trade for ever!"

These were some of the reasons given for holding aloof from the Milan Exhibition which closed its doors on Nov. 11th last, after having kept them open for a little over six months, and which was visited by over 5½ million people, or an average of close upon 30,000 per day. The total gate money amounted to about £175,000. On several days, in fact, the number who passed through the turnstiles was well over the 100,000, so that there could be no complaint as to the exhibits remaining unseen by possible customers, and no question as to the extent of the advertisement obtained by showing thereat. In point of size the Milan Exhibition, 1906, compared well with the largest recent exhibitions in Europe. It occupied 250 acres of ground, against 300 acres at Paris 1900, and 170 acres at Liége in 1905, with 340,000 sq. yds. of covered space, against 580,000 in Paris, and only 156,000 at Liége. The cost of construction of the buildings amounted to close upon £250,000, and a handsome drawback will be obtained from the original contractors for the materials of which they are composed, when demolished. The charge for space made by the exhibition authorities to exhibitors and exhibiting nations, inclusive of the special concessions and side shows, must have realised well over £120,000, so that with the £70,000 contributed by the Italian and other national authorities, it is not very likely that the £120,000 guaranteed by the citizens of Milan will be called upon to any serious extent to make good financial shortcomings. The number of exhibitors was 12,650, belonging to some 30 different nationalities, but only 12,000 competed for awards, and these between them obtained 10,153 awards, ranging from Grand Prix to Honourable Mention. Great Britain, which was represented by 333 exhibitors, of which over one half (54 per cent.) were actual manufacturers, obtained 340 awards, or over 1 1/16th awards per exhibitor, the average for the whole exhibition being only 0·81. For France, with her 3,370 exhibitors, it was 0·69; for Belgium, with her 1,060, it was 0·74; while for Germany, which alone of all the great nations beat Great Britain in respect to awards—the numbers were 428 and 1⅓ respectively. It is a fact that a relatively greater number of awards were bestowed at Milan than at other great International Exhibitions, but it should be remembered that it was not a Universal Exhibition, but one limited to a relatively small number of groups and classes; or, in other words, that considerable selection was exercised in gathering exhibits. For this reason almost all exhibits displayed there were possessed of unusual merits. The official judgment of the 1,320 jurymen serving on the international jury of awards, of whom only a little over 38 per cent. were Italians, bore flattering testimony to the excellence of the show in general, as the first three awards, down to the Gold Medal inclusive, formed over 62 per cent. of the total awards bestowed. The superior jury, composed of trained experts in the matter of great exhibitions, expressed unstinted admiration for what Milan, Italy and their International guests had done in producing a world's fair.

No one can estimate the specific benefits conferred on the individual exhibitor or on the trade of the country to which he belonged through having participated at a great exhibition like Milan. Neither is it possible to estimate the benefits conferred on the country and the city where the exhibition is held. A balance-sheet of profit and loss would be almost as difficult to frame in the one case as in the other. But apart from individual profit, it is unquestionable that the fact of this show having taken place has led to the establishment of fresh and more extensive relations between manufacturers and consumers, not in Italy alone, but in several of the neighbouring States as well, and in others connected by close ties of relationship and interest with Italy. These relations have embraced more or less all those who have exhibited at Milan, and have certainly not left British exhibitors out in the cold.

It is nothing either unusual or unexpected to find that British exhibitors come out particularly prominently in the groups and classes connected with maritime matters, and considering the acknowledgedly magnificent show made at Milan by our naval constructors and shipbuilders—the success of this Court was not to be wondered at, but when we find that we did proportionately quite as well in decorative arts, then we have some reason for satisfaction.

In agricultural machinery we certainly more than held our own in the excellence of our machinery and the prominence of our manufacturers. In textile machinery, again, we certainly held our own, notwithstanding the somewhat vexatious restrictions imposed upon exhibitors in the Working Hall, where these machines were displayed—that of not only turning them round but actually producing finished work therewith. The number of exhibits in the Working Hall owing to this condition was far more restricted than it would otherwise have been, but, on the whole, the 7,000 ft. odd of space occupied by this Court was creditable to the Mother Country.

It was a matter for considerable regret that our leading electrical firms should have abstained from exhibiting to the extent that they did, as it gave a wholly false impression of the position we occupy in the electrical industries in the world—all the more so considering the enormous demands which are being made for new industrial installations in Italy on all the electrical houses in that country as well as in Switzerland, Germany and France in which our own makers should participate. The same thing may be said in the case of manufacturers of railway stock and locomotives. Here the supply offering for several years to come from Italian sources is ridiculously short of the demand, and the Italian Government would have been influenced to a large extent in placing their orders with us had our leading houses exhibited, as they were repeatedly asked to do. As it is they have had to content themselves with limiting their custom in this country to a few second-hand locomotives purchased from the Midland and Metropolitan Railways for immediate delivery, while Belgian and German works, who made expensive and beautiful displays of rolling stock, have almost entirely monopolised the orders for future delivery.

Our other exhibits fell far short of what could have been

wished in point of numbers. We were very scantily represented in sanitary appliances, for which there is an immediate and increasing market in Northern Italy, where we should have stood easily first, and an undoubtedly good opportunity for creating a demand for our many excellent appliances of this character has been allowed to escape us. The remarkable results achieved under similar circumstances in France through exhibiting in Paris and elsewhere these same appliances, by which a new market was created therefor, has unfortunately been forgotten by the very firms who benefited by its creation in the former case.

The products of our fisheries and our fishing appliances were still less in evidence, although two or three of our best firms exhibited, and opportunity of pushing a trade in the latter in the Mediterranean, where trawling, for instance, is very much called for, has been also lost. It is noteworthy that the finest shows in fishing products and appliances were made by some of the newer exhibiting nations, anxious to create a trade in their products in new markets, such as China, Japan and Portugal, while Germany chiefly brought her fishing appliances to the notice of the Italian public, and doubtless secured many an order that might have gone to Great Britain.

Our miscellaneous industries—chemical, pharmaceutical, photographic, food preserving—were also numerically insignificantly represented, as were the cycle and automobile industries. What there was, was good, and obtained ample recognition at the hands of the jury of awards, but it was relatively unimportant both when compared with the importance of the home industries represented, and of the shows made by cognate industries in foreign countries. We can but deplore the fact, and deploring, point out that it was not the fault of the British Commission that this was the case, but of the lamentable want of appreciation of the opportunities offered by the Milan Exhibition on the part of those among our manufacturers who would have found it to their interest to participate. "Noblesse oblige" is a trite saying; yet its application to exhibitions among many other international matters is too often forgotten. The political standing of a nation in the comity of nations often compels it to take upon itself duties of a general character which are far from, or the reverse to, remunerative, and yet it dare not decline to do so, lest it should lose reputation, which is more valuable than money, indeed the loss of which could not be measured in millions sterling. Even so there are certain classes of exhibits which nations in the foremost rank may not neglect to make with impunity; exhibits that under no conceivable circumstances can be made to yield any direct profit. These are in the fields of social economy, of public hygiene and of public education. The world at large expects it of a nation to show the best it produces in these fields of human energy; the foremost results and greatest achievements have to be placed at the disposal of, and demonstrated to, humanity at large on all suitable occasions. International exhibitions are among the most suitable of these occasions, and a nation which does not avail itself thereof loses caste, as it were, among other nations. We did not exactly lose caste at Milan in these respects, but we went perilously close to doing so. British exhibits in social science and in public hygiene, with a few notable exceptions, were wholly unrepresentative of the position achieved by Great Britain, and especially of the reputation enjoyed by this country among foreign nations. Relatively we did a trifle better in matters scholastic, but not well enough to maintain our standing in the estimation of others.

To conclude our retrospect, the Milan Exhibition was indubitably one of the great exhibitions of modern times, and although not universal in scope, it was sufficiently wide to embrace most of the important products of modern industry, and invoked a response from the leading industrial nations of the most flattering character. It did not appeal to anything like the extent that it should have done to British manufacturers and traders, owing partly to a mistaken idea of its importance, partly to a misapprehension of the effect of the Italian Protectionist policy on the opportunities for trade in that country, partly to a disinclination to exhibit, largely engendered by self-sufficient complacency in our commercial position in the markets of the world—and partly on the lazy habit produced by over-prosperity in the past which prevents many from exerting themselves even when face to face with loss of business, and makes them inclined to cry "Kismet" when it is actually gone. Yet notwithstanding difficulties of this character, intensified in many cases to a wholly abnormal extent, the British representation at Milan, though by no means worthy of our position among nations, comprised much that was excellent, and stood relatively only slightly below Germany in the estimation of the International Jury, although the Government contribution per exhibitor in the latter case towards the expenses of the national display was half as much again as it was in the case of Great Britain, and will eventually prove probably over twice as much. It is abundantly clear that our somewhat halting participation had nothing whatever to justify it, and was a regrettable mistake from many points of view which it would not pay our manufacturers to repeat.

It is also abundantly clear that although the temporary organisation which looked after British interests in the matter of exhibiting at Milan achieved probably all that was possible considering the time at their disposal and the difficulties they had to encounter on the part of exhibitors themselves, Great Britain will never be adequately represented at International exhibitions till a permanent exhibition organisation has been formed which, by means of constant touch with the leaders of British trade, shall ensure their participation as a matter of course.

Under these circumstances the minor firms which are constantly being established, and with whom exhibitions are universally recognised, as one of the most practical methods of attaining prominence, will come forward without any question in their hundreds, and adequately fill up the ranks of the commercial army which ought to represent this country at International shows. One more word:—It is to be hoped that in the case of exhibitions, the usual result anticipated from Government Commissions will not evolve from the Departmental Committee now inquiring into the subject, *i.e.*, that it will not be in the fullness of official time decently shelved. The matter we are persuaded presses, and we cannot any more do without adequate representation at International Exhibitions than our shops can do without well-dressed windows on the street.

REVIEWS.

Applied Electricity. By J. Paley Yorke. London: Edward Arnold. 1906. Price 7s. 6d.

This volume is intended as a text-book of electrical engineering for second-year students. The reader is supposed to have an elementary knowledge of the fundamental principles of electricity and magnetism, and also some acquaintance with "Mechanics, Heat and Mathematics." The order in which the subjects are stated is the author's. The book is meant to bridge the gap between elementary text-books and the "many excellent specialised works" on the numerous branches of the subject.

We have not been favourably impressed with the book. In our opinion the author of an elementary treatise should strive, in the first place, to be accurate and lucid, and in the second, to be interesting. The impression that we obtain from a perusal of the book is that everything is being sacrificed in order to make the reader think that the theoretical points of greatest practical importance are beautifully simple, and that he can easily complete his further studies by a cursory glance at other works.

For instance, in the chapter on electro-magnetism, a proof is given that the number of lines of force per unit area inside a solenoid is $4\pi/10$ times the ampere-turns per unit length of the solenoid. The proof given applies equally well, whatever the length of the axis of the coil may be. Later on, however, the student will be startled to find (page 227) that "inside the solenoid there is a uniform magnetic field except at the end portions." The question will naturally arise—Why does the previous proof not apply to the end portions? The answer (page 227) apparently is, "Solenoids are generally made long compared with their diameter, and the irregularity at their ends may be neglected." It will be seen that the knowledge the student acquires is

shaky, and that he would not look forward to a *viva voce* examination with confidence.

The author sometimes expresses himself oddly. On page 3 he says :—"For the moment it is matterless how electricity moves," and on page 19 we come across "from this data." We fail to see (page 18) why the constant of a tangent galvanometer should be called "the electrolytic constant" of the galvanometer. On page 60, instead of talking about resistivity as being measured in terms of the cm. cube, the author talks about specific resistance per cm. per sq. cm. This a doubtful improvement.

No clear distinction is made between dielectric strength and resistivity. The reader would gather from p. 130 that air has an infinite electrical resistance, but when it is subjected to the mechanical stresses between two highly-charged electrodes this resistance will break down "due to some molecular change, and allow a spark to jump across." "Experiment goes to prove that some 27,500 volts are needed to cause a spark to jump across a centimetre air-gap." It should be stated that the voltage required varies enormously with the shape of the electrodes.

On p. 166, when comparing the relative merits of alternating and direct-current systems of supply, it is stated that the direct-current stations must run at the same pressure as they supply to their consumers. Some reference to high-tension direct-current systems seems to be required. On p. 241 it is stated that Lenz's law is "inevitable." "Given the fact that induced currents are set up whenever a magnetic flux is altered, it must follow that the magnetic effects of these currents will oppose and not help the change." For if not "then surely out of a small amount of energy would grow an ever-increasing and unending quantity. For if the induced current helped the change that caused it, its own magnetic flux would cause a greater change, which would in turn cause a greater induced E.M.F., and so on to infinity." This reasoning is quite as fallacious as the analogous reasoning about Achilles and the tortoise. The simple fact that an assumed effect increases in geometrical progression is no proof of the absurdity of the assumption. The effect of the repeated reflections of light from the walls of a room increases the illumination in the room, and this increase goes on to infinity, but surely it would be wrong to conclude that the reflections from the walls must diminish the light in the room.

On p. 358 it is stated that "the *average of the squares* of the sines of all angles between 0° and 90° is 0·499849." We always thought that it was exactly 0·5. "The quantity 0·499849 represents the power-factor of an alternating current whose average strength is 0·637 ampere." This statement is incomprehensible. The average strength of an alternating current is zero. It is startling to read about the power-factor of an alternating current, but the following (p. 358) is quite bewildering—"Now the quantity 0·406 represents a power-factor of a continuous current of 0·637 ampere."

Concerning synchronous motors, we read that "a small alteration of load and of speed will promptly put it out of step, and it will start pulling up" (p. 375). "In short, the synchronous motor is extremely troublesome. Nevertheless, the reader will be able to appreciate its possibilities." This may make the reader think, but if he knows nothing about the synchronous motor, but what he learns from this book, we shall be surprised if he can appreciate its possibilities. There are a few misprints. For instance, on p. 349, it is stated that one foot-pound = 13·56 joules, instead of 1·356 joules.

The Care and Management of Electric Power Plants. By Norman H. Schneider. London : E. & F. N. Spon, Ltd. 1906. Price 5s. net.

For a start we have an "Explanation of the Mathematical Signs Used," and we are informed that the multiplication sign × in 6 × 2 means that 6 is to be multiplied by 2 ; from which it would appear that theory was altogether to be eliminated. For the most part this is true, but in place of decent theory we are confronted by tedious numerical calculations that are more wearying than learning the algebra to do the thing direct.

The book, as a whole, does not appeal to the engineer. It is neither a book for practice, where the sub-divisions are plainly marked and where you can get at the point that is bothering you at once, nor yet a text-book in the true sense of the word, inasmuch as an attempt is made to cover both sections. Now, where an attempt is made in some 270 pages of small size and large type to cover the whole field of modern electric practice, that attempt is doomed to failure. We are at a loss to understand the title given to this book ; a much more appropriate one would be "Elementary Electrical Engineering."

There is some looseness discernible in the terms used. For instance, on page 12, in speaking of the voltage loss in wiring, it is stated that "this loss or drop is the *power* required to carry the current, &c."

Again, in the introduction, the author speaks of a *force* called electricity.

Such slips as these, which, by the way, betoken in many cases an inferior acquaintance with the laws and terminology of dynamics, are almost fatal in the hands of young students. The confusion of the terms "power" and "force" is one of the easiest things to get into the head of the learner, and one of the hardest to get out.

The book, on the whole, while not justifying its title, is still, doubtless, a useful collection of standard facts.

La Télégraphie Sans Fil. By J. Van Dam. Amsterdam : Scheltema and Holkema's Boekhandel. 1906. Price 5s.

The avowed intention of this work is to describe and illustrate the different systems and apparatus actually used at the present day in the art of Hertzian Wireless Telegraphy. The author therefore endeavours to avoid introducing descriptions of methods of wireless telegraphy having a purely historical interest, and excludes such as depend on conduction, induction, luminous radiation, &c., for their operation. The theoretical principles of electric wave propagation, syntony and wave-length measurements are dwelt upon at some length so far as they bear on the practical aspect of the question. In general the author approaches the subject in a clear and concise manner, but on well-worn tracks. There is nothing in the production as a whole which is particularly novel or noteworthy, and no fresh light is shed on foreign practice or on the commercial value of the systems described. As an exposition of practical systems, the work would have been more complete had it included the Lodge-Muirhead system, which is for some reason barely mentioned, nor is the well-known rotating-disk mercury coherer of that system included in the chapter on receiving appliances. On the other hand, a large number of the appliances described have now only a historical interest or even less. In this respect the work is not above the average of popular essays on wireless telegraphy, a lack of discrimination being evident which denotes a want of good practical touch with the subject. The last chapter deals with the state of legal control by various governments and appends the text of the *Protocole Final* of the Berlin Conference of A.D. 1903.

Analyse des Métaux par Electrolyse. By A. Holland and L. Bertiaux. Paris : H. Dunod & E. Pinat. 1906. Price 6 fr.

It is a lamentable fact that the present-day chemist ignores, almost completely, all electrolytic methods of analysis. This is due, in many cases, to a sheer ignorance of the elementary principles of electricity, and not to a lack of equipment. It is worthy of note that, whenever old prejudices have been overcome, this modern procedure has completely superseded the older laborious methods of analysis. So far the whole of the pioneer work has been left in the hands of some half dozen enthusiastic chemists—the authors included—until a degree of refinement, far in excess of that previously obtained, has been reached. Even the strong recommendation of standard text-books has done nothing further than raise a mild curiosity as to the nature of these mysterious methods. The present volume furnishes, therefore, a valuable addition to our modern scientific literature, especially as it gives the experiences of two such well-known and careful workers as Holland and Bertiaux. As regards the book itself, many notable omissions are to be

regretted. In the first chapter, which is devoted to the description of electrodes, no mention is made of the very convenient flag form. This latter is, without doubt, the simplest and best stationary electrode on the market. The mercury cathode also has received a lot of attention recently, but has been overlooked by the authors. The same remarks apply to rotating cathodes and anodes. Another fact apparently unknown, is that nickel may be employed as a cathode, in place of the time-honoured and expensive platinum. The following chapters, devoted to theoretical considerations, are simply and clearly written. It is noticeable that use is made of the old Caspari table of super-tensions, when the more accurate ones of Tafel are at hand, and evidently well known to the authors. The second part of the book is devoted to the electrolytic deposition of the different metals. This is accurate throughout, but there is a natural tendency to give too much prominence to the author's own methods at the expense of those of others. For example, antimony may be deposited in an adherent form from neutral tartrate solution, but no mention is made of the fact. In many cases the use of citric acid is recommended. This, along with many other complex organic acids, is objectionable, as carbon is liable to be deposited at the cathode. This leads to results a little too high, and, as a consequence, the simpler acids are to be preferred.

The third part of the book is, perhaps, the most useful of all. It contains the methods of analysis of the chief metals now on the market. These have been very carefully worked out, and the results of the various analyses are given in tabular form. A glance at these figures is sufficient to show the beautiful refinement of the methods employed; at the same time the tedious process of precipitation and filtration is almost avoided. The fourth part of the book gives the tabulated results of many experiments conducted by the authors, showing the degree of accuracy of their work.

The book will, without doubt, form a very valuable addition to any scientific library. Although incomplete in many ways, the methods are reliable and chosen from experience. To an electro-chemist the volume is invaluable.

Handbook of Practical Smithing and Forging. By Thomas Moore. London: E. and F. N. Spon, Ltd. 1906. Price 5s. net.

The subject of this treatise is one which is usually neglected by the general run of pupils in passing through their workshop training, and this omission can be largely rectified by a careful study of the work under review. In the preface the author claims a life experience as a smith, forger, stamper and foreman, and a perusal of the following chapters fully establishes the practical nature of his experience. After a few pages of introduction, Chapter II deals with the construction and design of various forges and hearths, together with notes on the most effective forms of blower; in this connection some mention might well have been made of the exhaust fans and trunks which are now so largely used to carry off the smoke and fumes instead of assuming the adoption of natural draught produced by a lofty chimney stack. In the latter part of this chapter the design of the various tools used in hand forging and the method of making them are fully described and illustrated.

The following seven pages are devoted to "Hammers, Forging Machines and Presses," but we are surprised to see no allusion to the "steam intensifier" type of press, which is now often installed in preference to a steam hammer, as it is equal in speed to the latter with all the advantages of a press, such as absence of noise and vibration, and the production of sounder forgings. Chapter IV goes fully into the characteristics of steel and wrought-iron, and explains the methods of manufacture. Practical tests, which can be carried out by a working smith, are treated of in the following chapter, in which also some allusion is made to chemical analysis and tensile strength; more attention, however, might have been paid to the latter point with advantage, and particulars of elastic limits, breaking strains, elongation, contraction of area, &c., could well have been given for different qualities of steel, including the higher grades which are coming into use in the construction of motor-cars. The final chapter describes the procedure to be followed in making forgings of every conceiveable form, and the methods put forward can be easily understood by the aid of the numerous woodcuts illustrating the different processes. At the end of the book several useful tables are given, followed by an index.

With the exceptions already mentioned, this work fully deals with the practical production of small and medium-sized forgings, and the descriptions of how the work should be carried out are written and illustrated in a simple and concise form which can be readily grasped.

Managers, foremen and workmen wishing to acquaint themselves with the work going on in the smithy, will find in this treatise an excellent means of fulfilling their desire.

EXHIBITIONS AND ELECTRICITY SUPPLY.

By R. BORLASE MATTHEWS, Wh. Ex., A.M.I.C.E.

An exhibition is perhaps the means that is most widely adopted by British electricity supply undertakings in developing a demand for their product, and a very successful means it has proved itself to be.

As an initial step in an aggressive campaign for new business an exhibition is undoubtedly a very valuable feature, but it is also apt to prove a costly venture unless properly backed up by a special canvass of the town, just before and during the period of the exhibition. It is very interesting to note that in the majority of instances where exhibitions have been held, the management consider that the outlay has been thoroughly justified by the returns in the shape of new business that they have been able to trace. No definite figures, however, seem to be available, as in most cases no records were kept or systematic canvassing attempted, the results all being indirect: very little being known about any increase of existing consumers' installations, and in the case of a new consumer it was evidently difficult to ascertain whether or not it was the outcome of the exhibition. What is certain, though, is that the number of new customers added during the period succeeding the exhibition has in every case exceeded that of the corresponding period of the previous year.

In the holding of an exhibition the electrical undertaking is but following the example of the gas companies, who, in conjunction with the manufacturers of gas cooking and heating appliances, have found exhibitions to be an extremely valuable factor in creating an increased demand for gas, giving them a greatly improved day load and a much larger income.

As an example of some actual results obtained by gas exhibitions, the following are of special interest as being recent cases. In a small sleepy inland town of some 20,000 inhabitants, over 260 gas cookers were sold during the time of the exhibition, as the result of an active canvass. Again, in a little seaside town with a population of about 9,000, where an active electric lighting company exists, 340 gas cookers were installed, as the outcome of an exhibition supported by thorough canvassing. In a town of nearly 80,000 inhabitants, where the municipal electrical undertaking is especially pushing and the rates for current are low, orders for over 2,000 gas cookers were obtained during the course of the exhibition. Yet this latter exhibition could not by any means be described as a good one; the hall was ill-ventilated, and the visitor was greeted with an overpowering smell of gas fumes combined with a very unpleasant heat. The Electricity Department, fired by this example, subsequently held, in a cheery and well-lit hall, an electrical exhibition, which was what an exhibition should be—interesting, attractive and educative. No canvassing, however, was done, beyond the distribution of a booklet which gave, in an interesting way, facts which a prospective consumer should know. Notwithstanding their abstention from canvassing, and the fact that a gas exhibition had only recently taken place, the results obtained were highly satisfactory.

An attractive showroom in a good location is, of course, a perpetual exhibition, and in comparison with the occasional elaborate display in a large hall, is, on the whole, much

more effective, since, as an educational factor, it produces steady but sure results year in and year out. The cost does not differ very much in either case. Each form of exhibition has its place in a general scheme of commercial development. In conjunction they will produce better results than either means alone. The temporary exhibition, by its size and by the wide advertising it receives, or should receive, is an excellent start for a new business-getting campaign, as it leaves such a good impression upon the minds of those who visit it, and even, more especially in the smaller towns, makes those who do not go to the exhibition appreciate that the central station is anxious to get customers and has something good to offer.

An exhibition cannot be held at lesser intervals than one year. Probably in most cases it would be wiser to make the interval greater, as, apart from the expense connected therewith, there will be the lack of that novelty which is so necessary to draw the people. An exhibition means the expenditure of a good deal of money on the part of the central station, so that, unless large numbers of people are attracted, it will not be worth holding.

To ensure a successful exhibition, it must be well advertised, by bills on the hoardings, by notes and paragraphs in the local Press, and by special invitations and other printed matter sent directly to the houses. An excellent idea is to make the opening a sort of social function, inviting the leading people of the town to, say, a private view before the public opening. It is advisable to provide music both in the afternoon, and during the course of the evening. Arrangements should be made for providing tea and coffee, prepared, of course, in electrically-heated vessels.

The exhibits should comprise, among other things, a demonstration of cooking by electricity, possibly accompanied by lectures on cooking, also a practical laundry, illustrating the use of the electric flat-iron, &c.

While the possibilities of the application of electricity are very interesting, a point that is often overlooked in exhibitions of the nature discussed here, is the necessity for absolute simplicity and directness of appeal of certain things. Too often a crowded dazzling display of nickel-plated and lacquered brass utensils and fittings is shown, which, though striking, does not attract the visitor as being within reach or suitable for his or her home, or place of business. Therefore, in some prominent place in the exhibition, apart from all other apparatus, a few of the simple serviceable devices which people should be encouraged to use in the beginning such as an electric flat-iron, a hot-plate and a radiator, should be prominently displayed; the prices of the apparatus being marked upon them in clear figures, a note as to where they can be obtained locally, a list of the uses they can be put to, and their special advantages, the cost of operating them per hour, or the number of hours they can be used for a penny. In conjunction with this simple exhibit might also be shown an example of electric lighting in its simplest form, the drop light, the chandelier and the table lamp, with data as to the cost of the fittings and the cost of lighting—all backed up by averages of the actual bills of present consumers, given not only as a total for the quarter, but also per day per lamp connected.

In accordance with the recent decision of the National Electrical Manufacturers' Association regarding country exhibitions, none of the electrical manufacturing firms are permitted to exhibit directly, this decision having been arrived at evidently with a view to putting an end to the excessive and useless expenditure brought about by each firm endeavouring to make their exhibit outvie their competitor's. It does not seem to be generally known, however, that while these firms cannot now exhibit individually, in most instances, if carriage is paid, they are very willing to loan apparatus to the central station or to local contractors for exhibition purposes. A certain amount of assistance can be obtained from the local wiring contractors, whose interest it is to exhibit; and certain other local firms, such as furniture dealers, are often glad to take advantage of such an excellent opportunity for advertising their goods. Furniture arranged in model rooms in conjunction with electric lighting and heating makes quite an attractive exhibit.

It is to be hoped that the National Electrical Manufacturers' Association or some similar allied association will, in the near future, draw up some scheme whereby the expense to the central stations in the holding of exhibitions may be modified to some extent. The members of this Association derive great benefit from these exhibitions, and so they ought to be prepared to bear their proportion of the expense.

Messrs. Edmundson's Electricity Corporation have a travelling exhibit which is moved in turn from town to town where they have electric light plants. In this way much of the labour connected with the actual preparation of the exhibits is avoided. If some such plan as this could be arranged by the Manufacturers' Association, it would be a great boon to the central stations, and much unnecessary carriage and other sources of expense in connection with an exhibition could be avoided.

A neatly printed souvenir booklet given to the visitors as they leave, affords an excellent means of bringing the object of the exhibition home, and the putting forth of convincing reasons as to why the house in which the recipient dwells should be wired.

It is very important to know who attends the exhibition, so that they may receive special attention from the canvassers, therefore one of the conditions of admission should be the presentation of a visiting card. Where an entirely free admission is adopted, the requirement of the production of a visiting card exercises a very desirable influence in keeping a certain rowdy element out. The rule as to the production of visiting cards is not intended to be a strict one, the main point being the obtaining of the name and address for the assistance of the canvassers, cards should, therefore, be provided at the doors for this purpose, for the use of those who do not happen to have visiting cards with them.

In all the smaller towns it is undoubtedly advisable to arrange that no charge should be made for admission, and even in the larger towns where a charge is made, there should be certain evenings or days upon which admission was free; in any event a liberal distribution of complimentary tickets should be made amongst prospective customers.

As an illustration of the attendances possible in a large city when a charge for admission is made, the instance of Sheffield may be cited, during the course of a three weeks' exhibition held in October last, over 25,000 persons paid for admission.

THE GERMAN ELECTRICAL ENGINEERING INDUSTRY IN 1906.

A Highly Prosperous Year.

The apprehensions which were entertained in Germany that the coming into operation of the new treaties of commerce with several European countries, which event took place on March 1st, 1906, and which was expected to bring about a reaction in trade in general, have not been fulfilled down to the present time. In fact, both the iron and steel and electrical industries have transacted a considerable amount of very remunerative business, as is shown by the favourable financial results of the companies concerned. Nevertheless, certain branches of the electrical industry are stated to have experienced a diminution in the export trade as a consequence of the new treaties, but the assertion must be accepted with some reserve until the official statistical returns are available for the whole of the past year.

The directors of the Siemens & Halske Co., in the course of their report for 1905-6, state that the orders and deliveries largely increased over the previous year. All the departments participated in the augmentation and yielded higher profits, and it is mentioned that the business results, as hitherto, were almost exclusively derived from manufacturing operations. The excessive competition experienced in some branches was, to a certain extent, compensated by the advantages obtained from the newly established works, which are arranged on a uniform principle. A summary of the accounts for the past two years is given below:—

	1905-6.	1904-5.
Share capital	£2,725,000	£2,725,000
Loan capital	1,385,000	1,413,000
Gross profits	515,623	451,077
Depreciation	74,265	61,970
Net profits	346,896	293,381
Dividend, per cent.	10	9
Carried forward	50,541	51,340

The report proceeds to state that the new works for signalling apparatus on the Nonnendamm were completed at the end of the

year, and have since then been started, the rooms thus rendered at liberty being taken possession of by the glow lamp department, whose productive capacity was thereby doubled. The company equipped 9 large and 10 small telephone exchanges, representing a total of 170,000 subscribers, and laid a telephone cable through the Lake of Constance for the telegraph departments of Bavaria, Wurtemberg and Switzerland. As to the Kjellin electric induction furnaces for the production of steel, a number of licences had been granted to large steel works, and furnaces up to 1,200 H.P. were put in hand. Large orders were received in the glow lamp department for tantalum lamps and lamps of 16 C.P. at 110 volts had been worked out and would be placed on the market as soon as the extensions of the over-loaded factory were completed. The company concluded licences with the General Electric Co., of New York, and the National Electric Co., of New Jersey, in regard to the manufacture of tantalum lamps. The construction of the new line (extension) of the Berlin Elevated and Underground Electric Railway was being carried out, together with the enlargement of the power station and additions to the rolling stock, and the company received, in conjunction with the Allgemeine Co., the order for the building of the Hamburg City and Suburban Railway, exclusive of the rolling stock and electrical equipment. The strike in October, 1905, led to the closing of the works for three weeks, and wages again increased during the year. According to the balance-sheet, the investments have risen from £2,963,000 in 1904-5 to £3,186,000 in 1905-6, and the sum of £2,252,500 out of the latter represents the company's holding in the Siemens-Schuckert works. The remainder is composed of interests held in the Austrian Siemens-Schuckert works, Siemens Bros. & Co., the Russian Siemens and Halske Co., and other firms.

The directors of the Siemens-Schuckert Works Co., which is an amalgamation of the heavy electrical engineering departments of the Siemens & Halske Co. and the Schuckert Co., have now for the first time issued a report and accounts in compliance with the request of shareholders. The report, which deals with 1905-6, states that the orders received during the year were 50 per cent. greater than in the preceding 12 months, and as a consequence it was necessary to proceed with extensions of existing works and the erection of new buildings both at Nuremberg and on the Nonnendamm, in Berlin. A large site was acquired at the latter place, and the construction was commenced of a large machine shop for the building of the largest dynamos. A motor-car factory was also started on the same site, and was brought into operation at the end of the year. The orders received for generators, motors and transformers represented a total of 709,616 KW., as compared with 421,862 KW. in the previous year. The report proceeds to remark that a considerable development took place in the electrical transmission of power at mining and ironworks, the work being specially characterised by the employment of large winding engines for shafts and of heavy reversing trains for steelworks. A large increase in activity was also manifested in regard to municipal electricity works, the principal work being in extension of existing stations. The project of a year ago for long-distance transmission at 50,000 volts had been put in hand, and the company received the orders for the necessary machines and transformers. An augmentation also took place in the Zoelly steam turbine branch, the use of electric lighting and power transmission on warships and mercantile vessels was further extended, electric tramways afforded increased orders, and the employment of high pressure direct current on the Cologne-Bonn Railway had proved to be economically advantageous. The accounts are as follows:—

	1905-6.	1904-5.
Share capital	£4,500,000	£4,000,000
Gross profits	627,392	—
Expenditure	58,914	—
Depreciation	118,894	108,680
Net profits	449,584	—

After providing £30,000 for bonuses and profit-sharing by staff and workmen and making other appropriations, there remains a surplus of £404,600 for division among the two proprietary companies, and this works out at about 9 per cent. if paid on the full capital of £4,500,000 for the whole of the year. The Schuckert Co. receives about 41 per cent. of the surplus or, say, £165,850, whilst the remainder represents the share of the Siemens & Halske Co. It is now proposed to strengthen the working capital of the Siemens-Schuckert Works by the issue of 4½ per cent. obligations amounting to £1,000,000.

The report of the Schuckert Co. (Electricitäts Gesellschaft vorm. Schuckert & Co) for 1905-6 states that the considerably increased business of the Siemens-Schuckert Works rendered it necessary to call up the last £500,000 of the original capital, and this fact and appropriations for extensions of the Nuremberg Co.'s undertakings has necessitated an increase in the latter's share capital. It was proposed to issue £400,000 in new shares which had been arranged to be taken over by a banking syndicate, who would offer £350,000 to existing shareholders in the proportion of one new share for six old shares. The directors also intended to participate in a financial operation for improving the position of the Continental Co. for Electrical Enterprises, in which the company has an extensive financial interest. The principal figures relating to the Schuckert Co.'s accounts are undernoted for the past two years:—

	1905-6.	1904-5.
Share capital...	£2,100,000	£2,100,000
Obligations	1,455,000	1,495,000
Gross profits	212,565	172,303
Net profits	114,060	73,622
Dividend, per cent.	5	4

As the gross profits amounted to £212,565, and the sum of £165,850 out of that total was derived from the Siemens-Schuckert Works, it will be seen that the balance of £46,715 represents the company's revenue from investments, electrical undertakings and other sources. The report gives particulars of the enterprises in which the company is interested and which are situated in various countries in Europe.

The Continental Co. for Electrical Enterprises (Continentale Gesellschaft fur Elektrische Unternehmungen) contemplates asking the shareholders to make an additional payment of £17 10s. per share for the purpose of reorganisation. Those shares upon which the money is paid will be entitled to a preference dividend of 5 per cent., and cumulative, whilst the remaining profits will be apportioned to the other shares to the extent of 4 per cent. It is proposed to devote the book profits arising from this operation to the purpose of extinguishing the debit balance, regulating outstanding debts and forming a reserve fund. When the transaction has been completed it is believed that a satisfactory development of the company can be depended upon, and the payment of a dividend is foreshadowed as probable for the current year. The Schuckert Co. holds over £1,400,000 of the company's shares, and is, therefore, considerably interested in this scheme of reconstruction.

The shareholders in the Telephonfabrik Gesellschaft (late G. Berliner), of Hanover, adopted the report and accounts at the recent general meeting and approved the payment of a dividend of 9 per cent. for 1905-6, being the same rate as in the preceding year. It appears from the report of the directors that the turnover increased by 20 per cent. over the year 1904-5, and the profits rose from £30,220 to £34,122 in 1905 6. After defraying the expenses of the issue of a 4½ per cent. obligation loan amounting to £50,000 and making provision for depreciation, the accounts show net profits totalling £16,278 as compared with £14,780 in the previous year, the share capital being £150,000. The report mentioned that the experiments with the automatic connecting telephone system were further continued, and were expected to lead to practical results within a conceivable period. As far as the current year is concerned, it was stated at the recent meeting that business was satisfactory and that sales continued to increase.

The Elektrische Licht und Kraft Anlagen Gesellschaft (Electric Light and Power Investment Co.), of Berlin, is interested directly or indirectly in numerous lighting stations, tramways, railways and manufacturing undertakings in various parts of the world. During 1905-6 the total revenue from securities and syndicate transactions increased, and a larger sum was received as interest, but commission was less and expenses slightly higher, so that the net results were not materially different from those obtained in the preceding year. The financial position may be summarised as follows:—

	1905-6.	1904-5.
Share capital (paid up) ...	£937,500	£937,500
Obligations	866,500	875,000
Net profits	85,271	85,104
Dividend, per cent.	7	7

The report presented at the recent meeting showed that the value of the securities in portfolio had risen from £941,500 in 1904-5 to £1,055,500 in 1905-6, and the syndicate participations from £366,000 to £605,000 respectively. At the general meeting, attention was drawn to the sale of shares amounting to £10,000 in the Berlin Elevated and Underground Electric Railway Co., and to the apparent inconsistency of this action with the decision of the directors to acquire £500,000 in new shares of the same railway company. It was explained on behalf of the management that the sale was effected by the Deutsche Bank, and that the name of the purchaser was unknown to the directors. A further question raised was in relation to the company's holding in the Underground Electric Railways Co. of London. The directors stated that the ordinary shares held in the London company had been completely written off, whilst 10 per cent. had been written off the profit-sharing notes amounting to £37,500, which were repayable in July, 1908.

The report of the Siemens Elektrische Betriebe (Siemens Electrical Managements Co.) for 1905-6 states that the Weimar lighting and tramway undertaking, which is worked by the company, exhibited an increase of 13 per cent. in the sales of energy for illuminating purposes, and of 7 per cent. in the number of passengers carried on the tramway. As to the six electricity works leased to the Siemens and Halske Co., the report mentioned that these were in a progressive state of development, and that the gross receipts were 34 per cent. in excess of those obtained in the preceding year. The accounts indicate net profits amounting to £16,582, as contrasted with £15,595 in 1904-5. It is proposed to pay a dividend at the rate of 5½ per cent. on the share capital of £250,000, or the same rate as was paid for 1904-5. The company also has obligation capital to the extent of £223,500, as compared with £229,500 in circulation a year ago.

Use of Telephones.—It is interesting to learn, from one of Mr. W. Duddell's Christmas lectures on "Signalling to a Distance," that the telephone is more fully utilised by London subscribers than by Americans. It appears that every London telephone is employed on the average 6 3 times daily, while in New York the figure is only 4·6.

THE BIRMINGHAM TRAMWAYS.

[By our Birmingham Correspondent.]

The Birmingham tramways have for years been anything but satisfactory. The old steam trams which have fumed and fretted along its streets have not inaptly been described as a "combination between a baked potato engine and a lethal chamber," and yet it was not until last week that they finally disappeared from view. To be more explicit, last Monday week, at midnight, the tramways of Birmingham passed out of the hands of the lessees, and will henceforth be worked by the municipal authorities—that is, with the exception of two routes—the Bristol Road and that between Colmore Row and Hockley—which have further terms still to run. Thus commences a new and important chapter in a story which has covered a period of nearly fifty years, the principal phases of which it will be of interest to recall.

We can touch but lightly on the earlier incidents, but in view of the agitation which is now going on against the proposed tramway to Harborne (one of Birmingham's most picturesque and wealthy suburbs) it will surprise the present generation to learn that the very first tramway projected in Birmingham was one along New Street, Paradise Street and Broad Street to Islington. So far back as 1860 George Francis Train approached the Town Council for leave to make a line to Edgbaston—probably for the reason that the route offered no awkward gradients—and the Council gave the required permission subject to the line being extended along the Hagley Road to Monument Lane. It was to be a comparatively simple affair—a flat-rail with a flange in the form of a raised step on the inner side, and it was to be laid longitudinally on baulks of timber set in the metalling or paving of the roadway. A model line and omnibus were submitted, but the new tramway never became an accomplished fact, as the promotor found it impossible to float the company.

The Introduction of Steam Traction.

As a matter of fact, the first promoters with whom the Town Council entered into actual working agreement were a company managed by a Mr. Busby (who some years previously had introduced an improved service of light omnibuses), and known as the Birmingham and District Tramway Co. The Birmingham Council had already determined that if any lines were to be made within their area they would make and maintain them. It was significant, perhaps, that the company alluded to got to work outside the borough boundary rather more quickly than it did within, and the first local line from Hockley to Dudley Port was opened in May, 1872. The first route inside municipal bounds was that from Hockley to Colmore Row, upon which cars began to run on September 7th, 1873. That line cost £15,000 to make, and was constructed on a broader gauge than is now used, being 4 ft. 8½ in. in width. The line was let to the company at a rent of £910 per annum. In 1875 the line was extended along Colmore Row, Paradise Street and Suffolk Street to Bristol Road, as far as Bournbrook, but, unfortunately, the company had to go into liquidation. A reconstruction followed under the title of the Birmingham Tramway and Omnibus Co., who, for lack of any other tenant, obtained a lease of the whole line from Hockley to Bournbrook for seven years, at an annual rent of £1,680. It was a bad bargain for the Corporation, whose outlay had been not less than £45,000, but the company made satisfactory dividends.

About this time there was a "boom" in tramways, due largely to the introduction in other towns of steam traction, and the first complete financial success which emerged from among many promotions in the early eighties was the Aston line, opened in 1882. This was the first to be constructed on the gauge of 3 ft. 6 in., and it was the first line to revert to the Corporation at the conclusion of the 21 years' lease, and it was the precedent for other working tenancies. The Aston Tramway Co. proved a steady 10 per cent. investment, though there was again a slight annual loss to the Corporation. Another steam route which followed was that of the Birmingham and Midland Tramway from Summer Row to Dudley Road. Other promotions quickly followed, which it is unnecessary here to specialise, and these were eventally taken over by a new organisation, called the Birmingham Central Tramways Co. which attracted a large number of local investors, though the result was a disappointment. It was for the Central Co. that the majority of the steam routes were constructed, and of which the leases have just fallen in.

The Accumulator Cars.

One notable success to which the company could lay claim, was the introduction of the cable system for the Handsworth route. After a very short experience, however, it was found desirable to change the directorate and rearrange the capital, and under the guidance of Mr. Jos. Smith (afterwards Mr. Ebbsmith), with Mr. Carruthers Wain as traffic manager, the business was put on a dividend-earning footing. Mr. Jos. Smith had great ideas as to the possibilities of electrical traction, and a proposal was made to use overhead electric wires on the Bristol Road route. This, however, was refused, and the company then tried the now famous experiment of running electric accumulator cars on this route. The system was continued for several years, but at a serious loss to the company. In 1896 permission was given to try the overhead system upon the Nechells route, but before it could be taken advantage of, Messrs. Ross and Mackenzie, two Canadian tramway experts, appeared upon the scene, and another important development followed.

Birmingham had long complained of the nuisance of the steam tramways and the lack of enterprise on the part of the Central Tramway Co., and Messrs. Ross and Mackenzie found little difficulty in forming the City of Birmingham Tramways Co., who bought up the interests of the old Central with a view to a large scheme of reconstruction, linking up the radiating lines so as to give through routes across the City, and of installing an improved system of traction. They proposed that they should surrender the ends of the existing leases, which had about ten years to run, and on the Council granting them a new term of 21 years, they undertook to pay the Corporation such a rent as would secure the municipality from loss, and at the same time abolish steam traction. The authorities and the public were prepared to jump at such a tempting offer, and how it came to be rejected forms another interesting link in the protracted and, at times, acrimonious negotiations which followed. In the meantime, however, overhead traction was installed on the Bristol Road route, and this lease—one of the last granted by the Corporation—runs until the end of the year 1911. The innovation was hailed with delight by the public, especially those living at Bournbrook and Selly Oak; the inhabitants on Bristol Road soon became reconciled to the overhead wires, and the experiment did much to remove the prejudice which had previously existed against them.

Matters appeared to be going on swimmingly at this time, and the people were eagerly anticipating the hour when Birmingham would be in line with other municipalities with regard to its tramways. Messrs. Ross and Mackenzie, it will be remembered, had offered to install a system satisfactory to the Corporation in lieu of the steam and accumulator cars; but it was lack of agreement as to this "form of traction satisfactory to the Corporation" that eventually led to the Council deciding to allow the leases to run out and afterwards themselves to work the traffic. The Public Works Committee actually recommended the acceptance of an agreement for granting new leases, and, despite a strenuous opposition, the Council resolved, by 33 votes to 23, to accept the Committee's recommendation.

Municipalisation.

Encouraged by this vote, the new City of Birmingham Tramways Co. took steps to promote a Bill for additional powers, Messrs. Ross and Mackenzie evidently intending to adopt electric traction by means of overhead wires. But a deputation of the Council which visited several Continental cities came back with a report in favour of the adoption of the conduit system exclusively for the whole of the city, and the negotiations which followed upon this report produced so much friction that the Public Works Committee called upon the company to withdraw their Bill, and in June, 1898, the the Council, by the narrow majority of 28 votes to 27, gave instructions to the Committee not to reopen negotiations. The backs of both parties were, figuratively speaking, now fairly "up," and from that moment all hopes of a friendly reconciliation vanished. The position was this:—The company were left with nothing but the remnants of the leases and the cars, engines and depôts purchased from their predecessors, whilst the Council and city had to still put up with steam traction and old-fashioned cars, when every other big city, to say nothing of much smaller and less wealthy towns, had up to-date tramways.

Eventually, in 1899, the Corporation decided to apply for Parliamentary powers to work the lines when the leases fell in, and at the same time a special Tramways Committee, with Alderman Beale as chairman, was appointed to take over the work which had previously been carried on by a sub-Committee of the Public Works Department. It has been due very largely to Mr. Beale's tact and energy that something like present day perfection has at length evolved from a world of chaos.

Much, however, had still to be done. By the time that a satisfactory General Powers Bill could be taken in hand a new factor had come upon the scene in the person of Mr. Emile Garcke, the guiding spirit of the British Electric Traction Co., which, in 1902, secured a dominating interest in the City of Birmingham Tramway Co and the Midland Tramway, which had similarly laid its hand upon every other available tramway enterprise in the district. Mr. Garcke very nearly succeeded in inducing the Corporation to go back on its decision to municipalise by a very much more tempting offer. Moreover, he made terms with the outside suburban authorities, who, with the high rent offered them, adopted the reverse to a friendly attitude towards the city. It was at the instigation of the B.E.T. Co. that these authorities promoted a Bill to obtain compulsory running powers over lines in the city, and an active opposition was organised to the new Bill of the Corporation, which, as a matter of fact, was passed only just in time to enable the Corporation to set about arrangements for taking over the working of the Aston route, of which the lease expired on December 31st, 1903.

Mr. Alfred Baker had just previously been appointed tramway manager, and early in January of the following year the first Birmingham municipal cars were running between the top of Bull Street and the municipal boundary in Aston Road. The outcome of further negotiations between the Councils of Birmingham and Aston was an agreement as to the number of cars each authority should put on and the adoption of a principle that each should be credited with the money earned in its own area. The first year's working of the Aston line was eminently satisfactory from a financial point of view.

The tramways in Aston have since been considerably extended, and a line between Aston and Erdington is practically complete. Negotiations, however, for a through service between Erdington and Aston, and also on the Newtown Row route have so far been unsuccessful. The principle of the financial arrangement on the Aston and Witton route affords the basis of other arrangements

affecting inter-change in the running of cars to outside districts. The next lines to be electrified were those to Dudley Road and Small Heath. Then, in 1904, the Tramways Committee, under the advice of its manager (Mr. Baker), prepared a general scheme involving the reconstruction of the unconverted steam routes, the provision of terminal loops and certain new lines. The latter included the Lodge Road route (which has been running since April last), the Icknield Port Road line (opened on October 17th), and the Bordesley Green route (opened in November).

Power for making these lines was obtained by the Birmingham Corporation Act, 1905, together with many other new routes and extensions of old ones. The Act authorised 32 miles of track and 20 miles of route. Not only has this been made with the exception of the more remote extensions to Saltley, but, happily, an arrangement was come to with the City of Birmingham Tramways Co., whereby the Corporation had access to the leased lines for the purposes of reconstruction. This was done in connection with the purchase of the lines in the old Balsall Heath district which were the property of the company. The Corporation paid liberally for these, giving a round sum of £20,000, in addition to £16,000 for the Kyotts Lake Road depôt, at the same time agreeing to reimburse the company for any loss of traffic during the reconstruction operations. The Corporation thereby gained an enormous advantage in being able to get all the work completed ready for the new method of municipal working. There has, of course, been much dislocation of traffic on these lines, and the public have suffered much inconvenience, but even that was better than having an interval of at least six months whilst the old lines were pulled up and replaced by new.

SMART ENGINEERING WORK.

In connection with this particular section of the work, it is impossible to withhold a word of praise to the contractors, Messrs. Dick, Kerr & Co., for the expeditious way in which they effected the changes. The Council have sanctioned an arrangement with the electricity department whereby the Tramway Committee will for the first four million units of energy which they take per annum pay 1½d. per unit, for the second four millions 1¼d. per unit, and the third four millions 1d. per unit; and Mr. Baker anticipates that when the system is in full operation the whole 12 million units will be required. A few weeks ago we published a fully-illustrated descriptive article on the new power station in Summer Lane.

The overhead section of the work, so far as the city of Birmingham is concerned, has been carried out by Messrs. Dick, Kerr & Co., who have also undertaken the reconstruction of the permanent way and the supply of the new cars. Altogether, 2,600 standards have been used in three different sizes. They are made entirely of rolled steel of varying thicknesses, and weigh respectively—"A" 766 lb., "B" 1,144 lb., "C" 1,129 lb., each being planted 6 ft. 6 in. deep in a bed of concrete. The trolley wires are supported by the usual 7/12 galvanised steel wire, having a breaking strain of not less than 4,666 lb.; similar wire is used for the flexible suspensions and bracket-arms. The guard wire is the usual 7/16, supported on spans of 7/14, and thimbles are used wherever the wire is nozzled. Pole straps are utilised wherever the wires are attached to the poles, the trolley-wire pole straps being 1½ in. by ⅜ in., and the guard-wire straps 1½ in. by ¼ in. Grooved trolley wire is used throughout, the sectional area being equal to that of 0000 S.W.G. round wire, and the breaking strain being equal to 22 tons per square inch. The wire is supplied in half-mile lengths. The ears are 9 in., 12 in., and 18 in. respectively, the last named, which are used on the curves, being built on one side in segments, in order to obviate any possible shearing of the screws. These ears are screwed for ¾ in. insulating bolts. The trolley wire has been erected in the usual half-mile sections, and air-gap section insulators have been used. Side bracket-arms in certain places, the longest being 16 ft., and the tube diameter 2 in. internal and 2⅜ in. external. These are screwed into specially heavy bracket-arm clamps, which latter are also used for the span carriers. The overhead work is adapted to the swivelling trolley head; oaken troughing is utilised wherever the wires pass under bridges. Some of the "outside" overhead work has been carried out by the Brush Electrical Engineering Co. and by Messrs. Blackwell & Co., Ltd.; whilst sections of the permanent-way reconstruction have been undertaken by Messrs. John Aird & Co., Messrs. Underwood & Co., and by Mr. Geo. Law, Kidderminster. The system in use is the centre-running span wire system.

The Corporation rolling stock consists of 220 cars, supplied by Messrs. Dick, Kerr & Co.—20 of a very large type, used upon the Aston line, carrying 60 or 70 passengers each and running on bogies; and the remainder on smaller dimensions better adapted for hilly routes. It is estimated from the experience of the lines already in operation, and taking the population of Birmingham as half a million, that the whole number will be carried in the course of the year a hundred times over. There has been a considerable re-arrangement of fares under which the penny fare will be equal to nearly two stages of the old steam tramways, in addition to which the journeys will be made with more celerity, the speed allowed by the Board of Trade varying from 4 to 12 miles an hour, according to the character of the routes.

When the total cost of the conversion comes to be reckoned up it will be found to be not far short of £1,000,000, irrespective of what is being spent by the Electric Supply Committee in respect of the trams. No fewer than 2,600 poles or standards have been erected to carry the trolley wires, the cost of the overhead equipment being £27,000. The making of the permanent way has cost upwards of £235,000, and a large sum has been expended in the purchase of the necessary properties and the widening of the streets. The cost of these street widenings is included in the tramway capital in Birmingham, whereas in some towns it is charged to the public works department. The new cars have cost something like £100,000, and the various depôts another £80,000. Despite this heavy cost, Birmingham folk will be satisfied now that they have got a satisfactory and up-to-date tramway system. It has been a long time coming, but "better late than never."

The entire work has been carried out under the supervision of Mr. Alfred Baker, the tramways manager, and his chief assistant, Mr. C. W. Hill. M. C. S. Bill, of the firm of Dick, Kerr & Co., superintended the overhead sections, and he has now joined the permanent staff of the Corporation, and will henceforward have charge of both the overhead work and the permanent way.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

29,320. "Electric switch." H. LUBECK. December 24th.

29,347. "Improvements relating to apparatus for operating with variations of potential in electric circuits." J. F. GILL. December 24th.

29,358. "Improvements in electric light contact insulation." M. HOCKER. December 24th.

29,367. "Improvements in the process of treating negative pole plates and product." J. BIJUR. December 24th. (Complete.)

29,394. "Improvements in or relating to electric arc lamps." H. J. J. JABURG. December 24th. (Complete.)

29,406. "Improvements in electric contact devices." A. A. KENT. (Date applied for under Patents Act, 1901, December 26th, 1905, being date of application in United States.) December 24th. (Complete.)

29,416. "Improvements in electrodes for arc lamps." GEBRUDER SIEMENS AND CO. (Date applied for under Patents Act, 1901, May 17th, 1906, being date of application in Germany.) December 24th. (Complete.)

29,420. "Improvements in and relating to telegraphic apparatus." S. F. JONES. December 24th. (Complete.)

29,423. "Improvements in and connected with the electric lighting of trains." W. R. PRESTON, C. ROE and C. H. ROE. December 24th.

29,434. "Improvements in chains for suspending electrical fittings, particularly electric lamps." VERITYS, LTD., and H. S. SMITH. December 27th. (Complete.)

29,439. "Improvements in or relating to stands or holders for telephone receivers and flexible receivers of speaking tubes." A. S. OSWALD. December 27th.

29,452. "An improved street or station indicator for electric tramcars and subway cars." D. LIVINGSTONE and W. DICKINSON. December 27th. (Complete.)

29,461. "Improvement in capstans for hauling wagons along or other machinery which is driven by an electric motor and placed below the level of the ground." L. HIGGINBOTTOM, T. MANNOCK and E. BROOME. December 27th.

29,494. "Improvements in electricity meters for testing purposes." ISARIA-ZAHLERWERKE G.m.b.H. (Date applied for under Patents Act, 1901, December 27th 1905, being date of application in Germany.) December 27th. (Complete.)

29,509. "Improvements in transmitters for wireless telegraphy." A. ORLING. December 27th.

29,512. "Electric current converter." H. CHAPMAN. December 28th.

29,545. "Tool for examining electric conductors." A. SCHEIBLER. December 28th. (Complete.)

29,584. "Improvements in and relating to circuit-controlling mechanism." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) December 28th.

21,585. "Improvements in dynamo-electric machines of the commutator type." THE BRITISH THOMSON-HOUSTON CO., LTD., and W. F. DAWSON. December 28th.

29,604. "Electric switches and cut-out." H. HILL and R. HACKING. December 29th.

29,616. "Improvements in or relating to electric mercury-vapour lamps." R. HOFFELT. (Date applied for under Patents Act, 1901, January 16th, 1906, being date of application in Germany. December 29th. (Complete.)

29,618. "Sectional poles for telephone, telegraph and trolley wires." H. M. SCIPLE. December 29th. (Complete.)

29,630. "Improvements in bayonet caps for electric glow lamps." G. DAVIS. December 29th.

29,639. "Improvements in connection with electric circuit breakers." W. H. SCOTT. December 29th.

29,647. "Method of connecting the lines in automatic telephones." F. MERK. (Date applied for under Patents Act, 1901, December 30th, 1905, being date of application in Germany.) December 29th. (Complete.)

29,652. "Improvements in or relating to electric circuit control systems." M. W. W. MACKIE. December 29th.

29,655. "Improvements in electrolytic apparatus." M. RUTHENBURG. December 29th.

29,657. "Improvements in or relating to arc lamps." E. J. C. CRETAUX. (Date applied for under Patents Act, 1901, December 30th, 1905, being date of application in France.) December 29th. (Complete.)

29,665. "Improvements relating to electrical apparatus for transmitting and receiving signals." A. T. DAWSON and G. T. BUCKHAM. December 29th.

29,669. "Automatic regulator of the ignition point of explosion motors." A. E. BRILLIE. (Date applied for under Patents Act, 1901, January 10th, 1906, being date of application in France.) December 29th. (Complete.)

29,692. "Improvements in and relating to commutators for dynamo-electric machines." F. H. LORING. December 31st.

29,706. "Improvements in electric switches." W. R. COMINGS. December 31st.

29,708. "Improved system of electric wiring." W. R. COMINGS. December 31st.

29,748. "Improvements in measuring instruments for electric storage batteries." H. BRAZIL and F. LYDALL. December 31st.

29,757. "Improvements in electrollers." F. C. DAFFORN. December 31st.

29,771. "Improvements in multiple-unit-controlling systems for electric railways, trains, and the like." ALMANNA SVENSKA ELEKTRISKA AKTIEBOLAGET. (Date applied for under Patents Act, 1901, January 2nd, 1906, being date of application in Sweden.) December 31st. (Complete.)